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Introduction

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-26998# Aeronautical Research Labs., Melbourne (Australia).

A HYPERSONIC WIND TUNNEL STUDY OF A THICK DELTA WING

D. C. Collis Nov. 1964 38 p refs
(ARL/A-232)

A wind tunnel study has been made at a Mach number of 7.1, of a wedge section (5.73° semi-angle) delta wing having a slightly blunt leading edge, and a sweepback angle of 76°. For most tests the Reynolds number based on centerline chord was about 3×10^5. Surface pressure distributions were measured in a spanwise direction at 88% chord, for incidences in the range 0 to 20°. Schlieren photographs, surface oil flow, and pitot traverses above the surface were used to determine the structure of the flow. Throughout the incidence range, the bow shock wave was detached from the leading edge, while the boundary layer remained attached around and inboard of the edge. At incidences above 7°, separation of the boundary layer occurred along a line which moved outboard with increasing incidence. Inboard of the separation line there was evidence of a pair of weak vortices overlying the surface. Author

N65-27157# Sandia Corp., Albuquerque, N. Mex.

STABILITY ANALYSIS OF THE RFD-2 FLIGHT TEST VEHICLE

F. L. Paris Jun. 1965 39 p refs
(SC-RR-65-129) CFSTI: $2.00

The theoretical and experimental determinations of the aerodynamic coefficients of the RFD-2 re-entry vehicle are presented. The resulting coefficients are incorporated into an aerodynamic analysis of the re-entry trajectory where the changes of configuration and the resultant changes in the physical and aerodynamic parameters of the vehicle are considered. Radar and camera-tracking data were obtained from the flight test which took place October 9, 1964. These experimental trajectory data correlated with the calculated trajectory within 400 feet of distance or 1 second of flight time throughout the re-entry flight. Author

N65-27220# Royal Aircraft Establishment, Farnborough (England).

THE CALCULATION OF THE PRESSURE DISTRIBUTION OVER AEROFOIL SECTIONS OF FINITE THICKNESS WITH AND WITHOUT FLAPS AND SLATS [BERECHNUNG DER DRUCKVERTEILUNG ENDLICH DICKER PROFILE OHNE UND MIT KLAPPEN UND VORFLUGELN]

K. Jacob and F. W. Riegels Mar. 1965 35 p refs Transl. into ENGLISH from Z. Flugwiss. (Brunswick, W. Germany), v. 11, no. 9, 1963 p 357–367
(RAE-LIB-TRANS-1101)

Two methods at present being used at the Aerodynamischen Versuchsanstalt Göttingen for calculating pressure distributions over aerofoil sections of finite thickness are presented, together with a further method allowing pressure distributions over aerofoil sections with slotted flaps and slats to be determined. All methods are applicable to problems of two-dimensional incompressible flow. Author

N65-27319# Litton Systems, Inc., St. Paul, Minn. Applied Science Div.

DETERMINATION OF THE SHAPE OF A FREE BALLOON: CYLINDER BALLOONS Scientific Report No. 5

Justin H. Smalley 20 Nov. 1964 18 p refs *Its* Rept.-2665
(Contract AF 19(628)-2783)
(AFCRL-65-156, AD-614609)

This report, the fifth in a series, presents numerical design data for purely cylinder balloons for sigma from zero to nearly 0.4. Meridional stresses also are given. Only zero superpressure is considered. In addition, some data are presented which give an insight into the method of solution for the tangent-harness type of balloon. Author

N65-27341# National Gas Turbine Establishment, Pyestock (England).

THE PERFORMANCE OF A TWO-STAGE TRANSONIC FAN

R. Staniforth and I. M. Davidson London, Min. of Aviation, Feb. 1961 26 p refs
(NGTE-M-345) (Declassified)

This Memorandum concerns a typical two-stage transonic fan designed in 1957 to match a hypothetical ducted fan engine of by-pass ratio 2.0. For reasons which are discussed at length the original design performance was not achieved, although the indications are that with certain modifications it may well be attainable. Since it is a preliminary account, no detail is given of the test techniques or instrument calibrations and checks etc. Author

N65-27342# Royal Aircraft Establishment, Farnborough (England).
HIGH SPEED TUNNEL TESTS ON A TWIN-ENGINED FIGHTER OF DELTA PLANFORM (GLOSTER F.4/48)
A. B. Haines and D. S. Capps Mar. 1950 44 p refs
(RAE-AERO-2359) (Declassified)

Tests have been made in the R.A.E. High Speed Tunnel on a 1/21st scale model of the Gloster F.4/48 fighter. The aircraft has a wing of delta planform with an aspect ratio of 3, a quarter chord sweepback of 39° and a thickness/chord ratio of 10%. The two power units are mounted side-by-side in a wide elliptic fuselage with entries ahead of the wing loading edge. The tailplane is also of delta planform (aspect ratio = 2.5). The tests were made at Mach numbers up to M = 0.93 at a Reynolds number of 0.66×10^6. The results showed that the Mach number for drag divergence ($\Delta C_D = 0.005$) was about 0.875 for $C_L = 0.2$, i.e., about 0.02 higher than the estimated value for the wing without body. Low speed pressure plotting tests confirmed that the body was sufficiently wide to maintain the full sweepback of the wing peak suction line into the wing body junction. Tests made with an alternative more waisted body showed little further improvement in drag. Results are also given showing the effects of detailed modifications to the external entry and cabin design. Author

N65-27348*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A WIND-TUNNEL STUDY OF GROUND-WIND LOADS ON LAUNCH VEHICLES INCLUDING THE EFFECTS OF CONDUITS AND ADJACENT STRUCTURES
George B. Mc Cullough and William J. Steinmetz Washington, NASA, Jul. 1965 95 p refs
(NASA-TN-D-2889) CFSTI: HC $3.00/MF $0.75 CSCL 01A

Steady ground winds were simulated at Reynolds numbers up to 5-1/2 million based on the diameter of the upper stage. Measurements were made of the dynamic and steady-state bending moments. It was found that circular conduits near the upstream stagnation line produced large dynamic response, whereas conduits on the lateral meridians tended to nullify the adverse effect of an upstream conduit. Fairing an upstream circular conduit to the vehicle with generous fillets also reduced its adverse effect. A rectangular umbilical mast directly upstream of a model produced a violent sinusoidal response of nearly constant amplitude. The magnitude of the response was reduced by increasing the spacing between the mast and the vehicle or by the addition of a plate to the upper portion of the mast which effectively increased the width of the wake of the mast. Selected data from tests of models of several specific vehicles are shown to illustrate the trends revealed by the tests of the simplified models. The effects observed with the simplified models are, in most cases, less pronounced for the more realistic specific vehicles. A brief statistical investigation of several selected vibration records suggested that the lateral dynamic response can be characterized as the sum of a sine wave plus a narrow-band gaussian noise. It was indicated that the lateral unsteady forces contain a damping component and are thus coupled to model motion. Author

N65-27400# Royal Aircraft Establishment, Farnborough (England).
LOW SPEED WIND TUNNEL TESTS ON A 1/10TH SCALE MODEL OF A TWIN JET AIRCRAFT, BRISTOL 188
J. W. Leathers London, Min. of Supply, Jul. 1957 85 p refs
(RAE-TN-AERO-2515) (Declassified)

With a plain leading edge the tail-on longitudinal stability is satisfactory up to the stall, but the no-tail pitching moment curves show that an upper surface leading edge separation starts from the inner wing at moderate C_L, and increases in extent with increase in C_L. Since this separation is known to be associated with the possibility of serious buffeting, two leading edge modifications to the inner wing were tried out—firstly leading edge flaps and secondly local strakes (small sharp-edged extensions) in the corners between the inner wing leading edge and the sides of the body or nacelles. Both devices delayed the onset of the flow separation up to or above the approach C_L. The strakes also caused a slight destabilizing effect with tail on at the higher C_L values. In all cases, when the wing separation bubble grows, the wing centre of pressure moves aft and a high downwash rate develops at the tailplane, so that the no-tail stability increases while the tailplane effectiveness reduces to nearly zero. Tests made at incidences above the stall show that a critical nose-up condition occurs in the region of 30°, but a small amount of nose-down trim is available for a C.G. position of 0.206$\bar{c}$. Tailplane power, however, has become very low. Sideslip does not appreciably effect the longitudinal stability, flaps down, but causes a small change in trim. Author

N65-27467# Royal Aircraft Establishment, Bedford (England).
LOW-SPEED WIND-TUNNEL TESTS ON A SERIES OF UNCAMBERED SLENDER POINTED WINGS WITH SHARP EDGES
D. H. Peckham London, Min. of Supply, Dec. 1958 148 p refs
(RAE-AERO-2613)

A series of three thick uncambered slender wings and twelve flat-plate slender wings, all with sharp edges, have been tested in the 13 ft × 9 ft low speed wind tunnel at R.A.E. Bedford. Pressure plotting, balance measurements and flow visualisation tests were made to investigate the effects of planform shape, thickness, and aspect ratio on their aerodynamic characteristics at low speeds. Author

N65-27661# Aeronautical Research Council (Gt. Brit.)
UPWASH INTERFERENCE ON WINGS OF FINITE SPAN IN A RECTANGULAR WIND TUNNEL WITH CLOSED SIDE WALLS AND POROUS-SLOTTED FLOOR AND ROOF
D. R. Holder London, HMSO, 1965 9 p refs
(ARC-R&M-3279) HMSO: 4s 6d

An exact solution is obtained for the upwash interference on wings of finite span in a rectangular wind tunnel with closed side walls and porous-slotted floor and roof. Author

N65-27816*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOCAL TURBULENT SKIN-FRICTION MEASUREMENTS ON A FLAT PLATE AT MACH NUMBERS FROM 2.5 TO 4.5 AND REYNOLDS NUMBERS UP TO 69×10^6
William J. Monta and Jerry M. Allen Washington, NASA, Jul. 1965 18 p refs
(NASA-TN-D-2896) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A wind-tunnel investigation has been conducted to measure local turbulent skin friction on a 10-foot-long flat-plate model at local Mach numbers of 2.46, 2.91, 3.47, and 4.44 over a Reynolds number range between 5×10^6 and 69×10^6. The skin-friction values measured in this investigation averaged between 0 and 5 percent above the predictions by the Sommer and Short T' method, but there differences may be within the accuracy of the measurements. Skin-friction balances with improved characteristics, together with surveys of the test flat-plate model, will be necessary in order to assess the reliability of the results. Author

N65-27894# Army Missile Command, Huntsville, Ala. Structures and Mechanics Lab.
A DIGITAL PROGRAM FOR CALCULATING COMBINED AERODYNAMIC PARAMETERS—SUBSONIC AND SUPERSONIC

J. R. Sandlin 3 May 1965 39 p ref See also NACA Rept.-1307
(RS-TR-65-4; NACA-1307; AD-465312)

A method is presented to take into account the interactions of the various components of a missile or aircraft using the combined aerodynamic parameters. Recommended theories, together with their applications and limits, and parameter data are given for determining design parameters. Also, an IBM 1620 computer program for design parameter determination is included. E.E.B.

N65-27919# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Structures Section
A LIFTING SURFACE METHOD FOR CALCULATING LOAD DISTRIBUTORS AND THE AERODYNAMIC INFLUENCE COEFFICIENT MATRIX FOR WINGS IN SUBSONIC FLOW
John Dulmovits Aug. 1964 52 p refs
(ADR-01-02-64.1)

A subsonic lifting surface method for determining the chordwise and spanwise pressure distributions of any wing at any subsonic Mach number has been developed and programed on the IBM 7094 computer. This method is capable of predicting loads due to angle-of-attack, twist, camber, and discontinuities such as flaps and ailerons. It was found that meaningful load distributions could be obtained by concentrating enough horseshoe vortices on the wing and satisfying the boundary condition that the downwash at certain points on the wing be equal to the slope of the mean camber line at these points. Using the Biot-Savart law with a Prandtl-Glauert Mach number correction a maximum of three hundred simultaneous equations are generated. Solution of these equations determines the load distribution. The lift distribution on the wing in the presence of a fuselage is calculated by a simple system of horseshoe vortices on the wing with images inside the fuselage. Author

N65-27928# RAND Corp., Santa Monica, Calif.
HYPERSONIC VISCOUS INTERACTION ON A SLENDER BODY OF REVOLUTION WITH SURFACE MASS TRANSFER
Ting Y. Li and Joseph F. Gross Sep. 1964 47 p refs Presented at the Ger. Soc. of Aerodynamics and Astronautics Ann. Meeting, Berlin, 14–18 Sep. 1964
(AD-610574)

An analytical formulation of the problem of hypersonic viscous interaction on a very slender body of revolution having a thick boundary layer and with surface mass transfer is presented. Particular attention was directed to establishing the mathematical restrictions necessary for the existence of similar solutions of the laminar layer equations for this class of problem. It is shown that similar solutions for the expanded case of surface mass transfer and binary mixture effects are possible only for three-quarter power law bodies of revolution. It was further shown that these similar solutions are characterized by the restrictive condition of a radial distance ratio equal to a constant. Also, the criterion of similar solutions for the problem of hypersonic interaction on a very slender body of revolution with a thick boundary layer and surface mass transfer is that the product of radial distance and radial flow velocity approximately equal to $x^{1/2}$ must govern the body surface shape and the surface injection velocity. E.E.B.

N65-27942*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF DEFLECTED WING TIPS ON THE AERODYNAMIC CHARACTERISTICS OF A CANARD CONFIGURATION AT MACH NUMBERS FROM 0.7 TO 3.5
Victor L. Peterson and Loren G. Bright Washington, NASA, Sep. 1960 89 p refs
(NASA-TM-X-392) CFSTI: HC $3.00/MF $0.75 CSCL 01A (Declassified)

An investigation has been conducted to determine the effects on the untrimmed and trimmed aerodynamic characteristics of two canard airplane configurations resulting from the downward deflection of the wing tips about hinge lines parallel to the body center line. One configuration had an aspect-ratio-2 triangular-wing plan form for which the outboard 16 percent of the area was deflectable. The second was derived from the first by replacing the deflectable triangular-wing tips with untapered surfaces of twice the area having the same sweep as the wing leading edge. Experimental longitudinal and sideslip data were obtained for several Mach numbers ranging from 0.70 to 3.54. The results showed that deflecting either the triangular tips or the swept tips significantly reduced supersonic longitudinal stability and increased directional stability. The effects on the stability were accompanied by reductions of lift-curve slope and increases in drag due to lift which resulted in reduced values of maximum untrimmed lift-drag ratio. Despite the detrimental effects of deflecting the tips on the maximum untrimmed lift-drag ratio, it is shown that the maximum trimmed lift-drag ratio can be either higher or lower with tips deflected than with tips undeflected, depending upon the stability level of the configuration with tips undeflected. Estimations of the effects of the deflected tips on the untrimmed aerodynamic characteristics were generally in fair agreement with the experimental results. Author

N65-27943*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STEADY AND FLUCTUATING PRESSURES AT TRANSONIC SPEEDS ON TWO SPACE-VEHICLE PAYLOAD SHAPES
Charles F. Coe Washington, NASA, Mar. 1962 55 p refs
(NASA-TM-X-503) CFSTI: HC $3.00/MF $0.50 CSCL 01A (Declassified)

Steady and fluctuating pressures have been measured at Mach numbers which were varied from 0.6 to 1.2 on two bodies of revolution typical of two space-vehicle payload shapes, the Centaur and the Able V. The results of the investigation showed that significant fluctuations of pressure occurred on both bodies between Mach numbers of 0.75 and 1.00. The maximum fluctuations measured at any Mach number and angle of attack occurred in the region of the normal shock wave as a result of shock-wave motion. Large regions of unsteady pressure also occurred as a result of separation on the converging afterbody of the Able V model. The maximum pressure fluctuations occurring on the bodies increased with increasing angle of attack. For angles other than 0°, fluctuations of normal force are indicated since pressure fluctuations were larger on the upper half of the bodies than on the lower half. No definite conclusions could be drawn regarding the form of the spectral densities of pressure fluctuations in the region of the shock wave. The spectral densities in regions of separation following the shock wave appeared flat except for some increase in energy level below 100 cycles per second, which may have been due to slight model motions. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-27010 National Aeronautics and Space Administration, Washington, D.C.
MATERIALS FOR THE MACH 3 SUPERSONIC TRANSPORT
George C. Deutsch *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 9 p (See N65-27000 16-34)

Some of the metallurgical problems that have been encountered with the structure of the Mach 3 supersonic transport and some of the progress that has been made towards solving these problems are presented. To date, most attention has been placed on the aircraft skin, however, programs on materials for thick sections components, the engines, and other parts are progressing rapidly. N.E.A.

N65-27665# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.
PRELIMINARY V/STOL CONTROL-DISPLAY SUBSYSTEM REQUIREMENTS STUDY Technical Documentary Report, 15 Jun. 1963–15 Mar. 1964
Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jun. 1964 150 p refs
(Contract AF 33(657)-11740)
(GR-1455; FDL-TDR-64-85; AD-610746)

A preliminary study of "V/STOL Control-Display Subsystem Requirements" was conducted. The analysis was primarily concerned with flight data, engine data, and the associated controls necessary for hover and transition of a high-performance V/STOL aircraft. Lift-cruise, vectored thrust, and lift fan configurations were studied. To support display and control analysis efforts, a full-scale cockpit mockup was constructed. As a result of project analysis and static evaluation conducted during the program, display requirements have been established for angle of attack, indicated airspeed, mach, absolute and barometric altitude, altitude rate, attitude, terminal guidance, and engine data. Areas requiring intensive control-display analysis to fully utilize the unique V/STOL capabilities include: lift engine instrumentation, low airspeed sensing and display, angle of attack during transition phases, and terminal guidance requirements. Author

N65-27727# Advisory Group for Aeronautical Research and Development, Paris (France).
THE IMPACT OF V/STOL AIRCRAFT ON INSTRUMENT WEATHER OPERATIONS
John P. Reeder (NASA, Langley Res. Center) Oct. 1964 21 p refs
(AGARD-485)

Considerable benefits can be gained by the use of V/STOL aircraft through the reduction of weather minima, in both civil and military operations. The paper discusses the present state of the art in instrument operation for helicopter and the problems and possibilities for other V/STOL aircraft. Air traffic control problems are also considered and suggestions are made for research and development programs using current V/STOL aircraft. It is concluded that there is a need for improvement in handling qualities and in pilot's instrument display, and for research to explore practical precision instrument approach techniques. Author

N65-27728# Advisory Group for Aeronautical Research and Development, Paris (France).
STATUS OF V/STOL STUDIES IN GERMANY
X. Hafer (Ernst Heinkel A.G.) Oct. 1964 24 p refs
(AGARD-486)

The paper describes three specific German V/STOL research projects using jet engines, including various combinations of jet lift, vectored thrust and tilting nacelles. These are the VJ 101C, the VAK 191 B, and, the Dornier Do 31. A general description of each machine is given, with details of the experimental program and aerodynamic and control system design. Author

N65-27729# Advisory Group for Aeronautical Research and Development, Paris (France).
APPROACH AND LANDING PROBLEMS IN JET VTOL AIRCRAFT
F. P. Youens (Short Bros. and Harland, Ltd.) Oct. 1964 36 p (AGARD-489)

The paper discusses the general problem of approach and landing for jet lift VTOL aircraft with emphasis on the tactical aircraft operating from a dispersed base. The influence of operational environment and the general characteristics of this type of aircraft on the approach technique is considered along with a more detailed survey of the transition phase including crosswind transition limits and control techniques. Against this general background the pilot's problem and the function of various instrument and control aids is considered. The paper refers to aircraft where applicable and to simulator assessment of the pilot's work load with varying degrees of instrument and automatic assistance. Author

N65-27731# Advisory Group for Aeronautical Research and Development, Paris (France).
AIRCRAFT CROSSWIND PERFORMANCE
J. F. O'Gara (Brit. Aircraft Corp., Preston) Oct. 1964 26 p refs (AGARD-492)

The aerodynamic aspects of take-off and landing in severe crosswinds are reviewed and an attempt is made to derive design criteria. For the approach and touchdown phases, alternative piloting techniques are described and minimum control requirements for a given crosswind are derived from flight data. The mechanics of the landing ground roll are then discussed, with particular emphasis on tyre effects; excessive lateral drift at high speed, especially on a wet runway, is shown to be the most critical factor and acceptable drift limits are established. The need for more experimental data, to support some of the assumptions made, is stressed. Author

N65-27732# Advisory Group for Aeronautical Research and Development, Paris (France).
THE INFLUENCE OF WEATHER ON AIRCRAFT OPERATIONS
J. Burnham (Roy. Aircraft Estab., Bedford) Oct. 1964 17 p (AGARD-494)

The effects of weather conditions on the flight of conventional fixed-wing aircraft are described in general terms. Gaps in current knowledge, particularly of atmospheric conditions, and the difficulties of giving direction or advice to the pilot as to what are limiting conditions, are briefly discussed. Author

N65-27814*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATE-VECTOR CONTROL APPLIED TO LATERAL STABILITY OF HIGH-PERFORMANCE AIRCRAFT
Waldo I. Oehman and Jerrold H. Suddath Washington, NASA, Jul. 1964 18 p
(NASA-TN-D-2894) CFSTI: HC $1.00/MF $0.50 CSCL 01D

State-vector control has been applied to the problem of lateral stability augmentation of high-performance aircraft. The problem considered was that of evaluating the feedback gains that would produce desired stability characteristics. The feedback gains are obtained as solutions of linear algebraic equations. A numerical example illustrates the practicability of the method. Author

N65-27937# General Dynamics/Convair, San Diego, Calif.
CRASHWORTHY DESIGN PRINCIPLES
D. L. Greer, J. S. Breedon, and T. L. Heid Sep. 1964 86 p refs (Contract FA-WA-4583)
(FAA-ADS-24)

This study provides a crashworthy design guide that will improve survivability in moderate to severe crash landings. The objectives of a crashworthy design are: (1) to retain an inhabitable shell around the occupants, (2) to keep the occupants restrained by their seats and the seats attached to the airframe structure, (3) to prevent injury due to local impact, and (4) to ensure means of rapid evacuation. The portion of the study related to evaluation includes only the effects of structural design considerations. Assurance that the emergency exit doors can be operated after fuselage distortions due to a crash can be provided by reinforcing the framing structure and the operating mechanism. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-26936# Picatinny Arsenal, Dover, N. J. Technical Services Lab.
DESIGN AND APPLICATION OF AN INCREMENTAL MAGNETIC COUNTER
Edward A. Gurtler Jan. 1964 22 p
(TM-1304/2; AD-426762)

This report is an integration of 5 phases of the work on incremental counters by the Instrumentation Section: 1. A short explanation of the incremental technique. 2. An investigation of core characteristics with the incremental technique as an application. 3. The steps taken to design an operational incremental counter. 4. An explanation of the operation of the aforementioned counter. 5. A proposed program for an end item fuze timer. An incremental counter does exactly what its name implies, it uses a torroidal magnetic core which stores an increment of flux for each cycle of operation of the driving oscillator. One cycle of oscillator operation is shaped or formed into a pulse of some voltage time. This pulse is then fed to a core which stores an increment of flux generated by the voltage time pulse. Author

N65-26941# Harshaw Chemical Co., Cleveland, Ohio. Crystal-Solid State Div.
RESEARCH ON PHOTOVOLTAIC CELLS Quarterly Progress Report, 1 Nov. 1964–31 Jan. 1965
Donald J. Harvey and Norman E. Heyerdahl Feb. 1965 24 p refs
(Contract AF 33(657)-7916)
(QPR-11; AD-461595)

Experiments were conducted for evaluating the factors involved in fabricating solar cells by the method of chemically reacting coevaporated CdTe films with copper ions in solution. The evaporation rate for various sources was determined, the effect of substrate temperature and heat treatments was examined; and the influence of doping level and Cd/Te_2 vapor flux ratio was determined. The results indicate that the vapor composition strongly influences the properties of the CdTe film. Measurements on impingement force and deposition rates were made by an electromagnetic microbalance technique, and graphs are given depicting the Cd deposition rate versus evaporation time for several sources. Spectral response for the solar cells on Mo was correlated with the transmission of solar cells on glass, which in turn could be correlated with sheet resistance of copper content of the barrier layer. Graphs plotting copper concentration against sheet resistance, and copper concentration against the square root of the plating time are included. L.S.

N65-27182# Honeywell, Inc., Hopkins, Minn. Ordnance Div.
LOW INPUT VOLTAGE CONVERSION Third Quarterly Progress Report, 1 Sep.–30 Nov. 1964
Kenneth J. Jenson and John T. Lingle [1964] 38 p
(Contract DA-28-043-AMC-00030(E))
(Rept.-3; AD-615330)

During this quarter, effort has been directed towards the design and fabrication of a low input voltage converter-regulator for test with a thermionic diode source. Also fuel cell-low input voltage converter-regulator load system tests have been conducted with excellent results. The 200 watt low input voltage converter-regulator fabricated during the previous quarter was operated from two series connected fuel cells and from a four fuel cell series-parallel stack. With the fuel cells as a source, the converter provided a 135 watt regulated 28 volt output with an efficiency of 85%. This system satisfactorily powered a 28 volt dc motor during starting, stalling, motor reversal, and normal running tests. The system also performed satisfactorily when subjected to slowly increasing overloads and sudden dead shorts. These tests have verified that the low input voltage converter-regulator circuit works well with a fuel cell source and that no unstable operating modes occur. Thus, fuel cell–low input voltage converter-regulator systems can provide a practical and reliable means of achieving useful higher voltage regulated power for operation of electronic equipment in remote areas. Author

N65-27206# General Motors Corp., Santa Barbara, Calif. Engineering Physics Lab.
STUDY OF A THERMOPHOTOVOLTAIC CONVERTER Final Report, 10 Nov. 1964–14 Jan. 1965
Apr. 1965 46 p refs *Its* Rept.-3
(Contract DA-28-043-AMC-00067(E))
(TR-65-23; AD-462029)

Convective and radiative loss measurements were refined on a model TPV system using a calorimeter in vacuum and air. The system has an inner cylindrical mantle (3.75-cm radius) heated internally by conventional fuels, a concentric photocell mount (12.5-cm radius), and reflecting end-mirrors. Power losses in the model system were 0.3 kw to the bottom mirror and 0.4 kw to the top (in vacuum), with additional losses in air cylinder, and 0.3 kw to the top. Sample studies have shown that highly reflecting ohmic contacts can be produced with a resistance of 0.001 $\Omega\text{-cm}^2$ on p-type, and 0.1 $\Omega\text{-cm}^2$ on lightly doped n-type. Additional cells of the "non-absorptive" type were produced. Wafers prepared under similar conditions were anti-reflection-coated on both surfaces for maximum transmission at 2.35 microns. The one-way absorption was found to be 3.4%. The devices performed as well or better than the earlier ones: typical performance at an estimated 15 watts per cell, incident power, was $V_{oc} = 0.30$ volts, $I_{sc} = 2.5$ amps, $P_{max} = 0.35$ watts, yielding a curve factor of 0.45. Author

N65-27317# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Space and Defense Sciences Dept.
25 KVA HYDROCARBON–AIR FUEL CELL SYSTEM Technical Summary Report, 11 Jun. 1963–15 Mar. 1965
Merle L. Engle Mar. 1965 147 p
(Contract DA-44-009-AMC-240(T); ARPA Order 430)
(AD-614717)

Progress is reported on the development of a reformer–fuel cell system supplying 5 kilovolt-amperes ac at 120 volts from a liquid hydrocarbon fuel and ambient air oxidant. The fuel cell, reformer, and inverter which comprise the powerplant, are discussed and their integration into the total system is explained. The electrical controls, and the tentative operating and maintenance procedures are discussed. The fuel cell system is presented with discussions of the design, function, and control of its various subsystems. The fuel cell module is analyzed as to its configuration, components, weight, and operation. Appendixes include calculations, equipment specifications, and test reports. R.N.A.

N65-27367*# General Motors Corp., Anderson, Ind. Delco-Remy Div.

HEAT STERILIZABLE SILVER-ZINC BATTERY INVESTIGATION Final Report

R. S. Bogner 15 Mar. 1965 152 p Prepared for JPL

(Contracts NAS7-100; JPL-950364)

(NASA-CR-63597) CFSTI: HC $5.00/MF $1.00 CSCL 10C

Secondary silver oxide–zinc cells and cell components are under study to determine their ability to survive heat sterilization at 145° C for 36 hours. The effect of a component's degradation products was determined by filling cells of standard construction with the electrolyte obtained from the sterilized cell component and noting cell electrical characteristics. Positive and negative plates were sterilized independently and assembled into cells with unsterilized materials. These tests indicated that the prime cause of failure was due to degradation products from the separator materials. The sterilized materials were built into the cells, and the polyethylene base material produced the best results; however, when sterilized in situ cell capacity was decreased by 50%. It was noted that the positive plates were attacked by the separator degradation products, and cells were redesigned to minimize the effect of these attacks. It was found that the PVA binder could be removed without adversely affecting the negative plates. The sterilization liquors from nylon, Celcon, and Penton case materials did not have adverse effects on cell performance. R.W.H.

N65-27546# Eagle-Picher Co., Joplin, Mo. Couples Dept.

INVESTIGATIONS LEADING TO THE DESIGN AND DEVELOPMENT OF MAGNESIUM/MAGNESIUM PERCHLORATE BATTERIES Second Quarterly Progress Report, Oct. 1–Dec. 31, 1964

James Sharpe 31 Jan. 1965 42 p

(Contract DA-28-043-AMC-00221(E))

(Rept.-2; AD-615342)

This abstract describes the significant accomplishments made on the research and development of magnesium/magnesium perchlorate batteries during the past three months. Efficiency has been improved by the addition of lithium chromate to the magnesium perchlorate. Studies have indicated that the addition of one gram of lithium chromate per 100 ml of electrolyte will increase the anode efficiency in the range of five to fifteen percent. Conductivity studies were carried out and studies indicated that four normal magnesium perchlorate is the most applicable to use. Data has also indicated the higher the normality of electrolyte, the lower the resistance. Effort has been directed during the quarter to perfect a magnesium/magnesium perchlorate battery which would meet the requirements of the AN/PRC-62 specification, when discharged over a temperature range of −40° F to +125° F. The program was directed toward attaining the optimum performance at −40° F with the minimum number of cells per battery. After this was completed, two units were constructed and discharged at +78° F and +125° F. Research in relation to positive and negative material was continued to reduce the cost of the battery and to keep its efficiency and reliability. The AN/PRC-25 application was studied. The same problems that existed with the AN/PRC-62 application were found to exist in regard to this application. Toward the end of the quarter, research and development was launched to meet the specifications of the PPS-5 application. Author

N65-27554# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.

A PRELIMINARY STUDY OF FACTORS AFFECTING MAGNESIUM DRY CELL PERFORMANCE CHARACTERISTICS

Donald B. Wood Feb. 1965 24 p refs

(ECOM-2561; AD-615114)

Preliminary investigations were carried out to determine the cell parameters that influence the "delayed action" of "N" size magnesium dry cells when subjected to the duty cycle and drain rate encountered in the AN/PRT-4 radio set. High concentrations (5N) of magnesium perchlorate electrolyte, protective films such as Cramolin, applied to the anode, and low concentrations of chromate ion were found to be beneficial in reducing the delayed action characteristic of the magnesium dry cell, but had a deleterious influence on the service capacity of the cell. Cells incorporating more active electrolytes such as $MgCl_2$, LiCl and $MgBr_2$ and various mixed perchlorates and mixed bromides were evaluated. None of these electrolytes resulted in cells that performed better than cells incorporating magnesium perchlorate electrolyte when both delayed action and service capacity were considered. There is little difference between cells made with AZ10 alloy cans and AZ21 cans with regard to service and delayed action characteristics. Author

N65-27619*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.

SPACE ELECTRIC POWER SYSTEMS STUDY: D-C TO D-C CONVERTERS FOR NUCLEAR-THERMIONIC ENERGY SOURCES

E. F. Swiderski, R. D. Jessee, and G. E. Gerecke May 1965 174 p refs

(Contract NAS3-6011)

(NASA-CR-54415; WAED65-28E) CFSTI: HC $5.00/MF $1.00 CSCL 10A

The results of a study of dc to dc converters used in a 3.25 megawatt power system for space ion thrustor electric propulsion are presented. It was shown that converters become attractive at the higher input voltages and are more efficient, less complex, and lighter than those with lower input voltages. The weight, efficiency, and volume of the converters are dependent on the inverter switching frequency. The switching frequency that results in an optimum converter design can be determined by investigating the converter weight as a function of frequency when source and thermal radiator penalties are considered because of power losses. Multiple channel systems offer a means to improve reliability through redundancy. With identical requirements and equal voltage inputs and outputs, a group of such converters working together from a properly rated power source will weigh less than a single converter operating from a single source. It was recommended that future efforts be directed to building several breadboard units, with a preferable rating of 30 kilowatts, to confirm converter operation, weight, size, and efficiency when operating into an ion engine simulated load from a source simulating a nuclear-thermionic characteristic. R.W.H.

N65-27630# Naval Research Lab., Washington, D. C. Library Branch.

DIRECT ENERGY CONVERSION LITERATURE ABSTRACTS Bibliography

Jun. 1965 120 p refs

CFSTI: $2.50

Abstracts of unclassified literature relating to the direct conversion of energy are covered under the subjects of general information, thermoelectricity, thermionic emission, photoelectric processes, magnetohydrodynamics, electrochemical processes, energy storage and sources, and regulation and control. An author index is included. M.W.R.

N65-27652# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.

INVESTIGATIONS ON LIQUID AMMONIA CELLS

Achille L. Almerini Jan. 1965 30 p refs

(ECOM-2562; AD-615079)

A number of investigations were performed on Mg-liquid NH_3-AgCl cells to evaluate and optimize a new technique (hot dry press) for forming AgCl cathodes and also to demonstrate feasibility of a mixed salt electrolyte (KSCN:$KClO_4$ in liquid ammonia). The hot dry pressed AgCl cathode appeared to be as efficient as the conventionally water pasted cathode and showed greater ease in fabrication, shorter fabrication time and better adaptability for higher weight electrodes. The mixed salt electrolyte 35:10 KSCN:$KClO_4$ increased the energy output of the Mg-AgCl system by 20% at −65° F, while reducing the vapor pressure of the previously used 35% KSCN by 50 psi at +125° F. The factorial design plans used are discussed in detail, with emphasis on planning, evaluation of results and use of significant factor level ranges in subsequent experiments. Author

N65-27738*# Union Carbide Corp., Parma, Ohio. Parma Research Lab.

STUDY PROGRAM TO IMPROVE FUEL CELL PERFORMANCE BY PULSING TECHNIQUES Third Quarterly Report, Ending May 31, 1965

M. L. Kronenberg [1965] 30 p refs

(Contract NAS3-6460)

(NASA-CR-54437) CFSTI: HC $2.00/MF $0.50 CSCL 10A

It has been observed that heavy discharge pulses show varying degrees of improvement on the performance level of different type fuel cell electrodes. The purpose of this investigation is to define these conditions, and to conduct studies to develop an understanding of this pulsing effect. Earlier results indicated that pulsing is primarily a catalyst reactivation treatment and is most effective in improving the performance of electrodes that are catalyst limited from the start, or become catalyst limited during the life of the electrode. Studies on nonporous platinum metal electrodes show that these electrodes show rapid losses in catalytic activity with time in a H_2-saturation solution. However, the catalytic activity can be restored electrochemically by oxidative (anodic) pulses, or by chemical oxidation. Recent studies have determined how various factors such as pulse duration, environmental factors, and temperature variation influence the decay rate of catalytic activity. Author

N65-27818*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A LONG-LIFE THERMAL CELL

Lawrence H. Thaller Washington, NASA, Jul. 1965 18 p refs

(NASA-TN-D-2915) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Primary thermal cells using molten salt electrolytes were constructed that had service lives measured in days, and seven research cells were discharged at elevated temperatures of 800° to 1000° F. These cells consisted of magnesium anodes, mixed copper oxide cathodes, and an electrolyte of the eutectic mixture of lithium chloride and potassium chloride. Comparison of the amount of current delivered during discharge with the quantities of materials found in the analyses showed the electrode efficiencies varied from 73 percent for a cell that was discharged over a period of 6 days to 93 percent for a cell that was discharged over a period of 1 day. The open circuit voltage of these cells (1.55 V) was about 1/2 volt less than expected from thermodynamic considerations. Current-voltage characteristics of one of these cells showed a total internal resistance of about 0.5 ohm at 800° F. The time dependence of the concentration polarization for the glass cell was also measured. For these nonoptimized research cells, energy densities of 28 watt-hour per pound of total battery were shown. Author

N65-27830*# Thermo Electron Engineering Corp., Waltham, Mass.

THERMAL ENERGY STORAGE/CONVERTER PROTOTYPE DESIGN, FABRICATION AND TESTING Third Monthly Progress Report, 3 May–2 Jun. 1965

S. G. Merra and L. van Someren [1965] 22 p Prepared for JPL

(Contracts NAS7-100; JPL-950976)

(NASA-CR-63725; TE-84-65) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Progress toward development of a thermal energy storage feasibility model is described. The model is to include a sealed rhenium capsule containing 3BeO-2MgO, and a thermionic converter modified to accommodate the capsule, the capsule heater, and thermal shielding. The model is to be tested for 16 cycles at 50° C above and below the melting point of the oxide. An electron bombardment heater was built and tested using various diameters of tungsten and rhenium wire. Fifteen mil tungsten appears to be the best choice for the feasibility model heater. Under similar operating conditions rhenium wire did not demonstrate the same life capability as tungsten. Results of a component test indicate that rhenium sleeves can be used in the converter. A full scale version of the thermal shield assembly was built. Purification of MgO and BeO powders is continuing. J.M.D.

N65-27835# Rocketdyne, Canoga Park, Calif.

HIGH-ENERGY BATTERY SYSTEM STUDY Sixth Quarterly Progress Report, 1 Oct.–31 Dec. 1964

J. Farrar, R. Keller, M. M. Nicholson [1964] 24 p refs *Its* Rept.-6

(Contract DA-36-039-AMC-03201(E))

(R-5405-6; AD-616385)

The behavior of high-energy cathode systems in lithium bromide–propylene carbonate electrolyte was investigated by galvanostatic polarization curves and prolonged discharge tests. An effort was made to promote the reduction of silver (II) oxide in the organic medium by means of additives that could act as receivers for the oxide ion. Water at concentrations of up to 10 percent was not effective for this purpose. Three solid oxygen receivers, $K_2S_2O_7$, $Na_2S_2O_5$, and $Na_4P_2O_7$, did not improve the cathodic behavior of silver oxide. Other cathode materials investigated were cupric iodate, potassium persulfate, cupric fluoride, and (as a comparison system) silver chloride. The iodate and persulfate were inactive in the propylene carbonate electrolyte, but apparent utilization efficiencies of 31 and 70 percent were achieved for the reduction of cupric fluoride and silver chloride, respectively. Author

N65-27847# Ionics, Inc., Cambridge, Mass.

HYDROGEN-BROMINE FUEL CELL Final Report, Apr. 1961–Oct. 1963

Werner Glass Bedford, Mass., AFCRL, 11 Dec. 1964 61 p refs

(Contract AF 19(604)-8508)

(AFCRL-65-34; AD-616108)

The exoenergetic formation of HBr from the elements and the endoenergetic dissociation of HBr into H_2 and Br_2 can be carried out reversibly in a fuel cell. Various problems associated with the construction of practical cells were studied.

Platinum, tantalum, niobium and tri or tetrafluoroethylene polymers were found to be acceptable materials of construction. Aqueous HBr was determined to be the best solubilizer for Br_2. Properties of $HBr\text{-}Br_2\text{-}H_2O$ solutions were investigated in considerable detail. The Br_2 solubilized by the HBr was found to act electrochemically mainly as an inert diluent. A special low-water-content ion exchange membrane minimized diffusive attack of Br_2 on the anode and permitted cell life to be extended to well over a year. The chemical composition of this membrane could be changed considerably by partial bromination without affecting fuel cell performance. The effective internal resistance of present cells is still high: on the order of 8 ohm-cm^2 of which half is directly due to the ion exchange membrane. Author

N65-27866# Pennsylvania State Univ., University Park. Mineral Industries Experiment Station.
BIBLIOGRAPHY OF FUEL CELL CONTRACTS
Harry Lerner and L. G. Austin Jan. 1965 29 p refs
(Contract DA-49-186-AMC-146(D))
(Rept.-8; AD-465981)

N65-27947*# Hughes Aircraft Co., Culver City, Calif.
RIGIDIZED INFLATABLE SOLAR ENERGY CONCENTRATORS, 1 AUGUST 1963–25 DECEMBER 1964
S. Schwartz and J. Bagby Washington, NASA, Jul. 1965 91 p
(Contract NAS1-3244)
(NASA-CR-254) CFSTI: HC $3.00/MF $0.75 CSCL 10B

The development of two processes for fabrication in a space environment of five-foot diameter inflatable, rigidizable solar energy concentrators is described. The reflective surface of each concentrator was two-mil aluminized polyester film formed to the desired paraboloidal shape by the Hughes stress-relaxation process. One process uses an ultra-violet activated polyester-fiberglass laminate for rigidization. The other process uses an epoxy syntactic foam activated by infrared radiation. A precoated paraboloid of each type was erected and rigidized in vacuum. The ability to package either paraboloid in a small volume and then to automatically eject and expand it to shape was demonstrated. Physical property tests were run on samples of each rigidized material. Optical and calorimetric tests were made on a five-foot paraboloid of each type. Both structures were found to be near paraboloids with efficiencies of 40 to 45% at area ratios of 900. The target weight of 0.4 lb per sq. ft. and reflectivities of 80% were achieved. Author

N65-27957*# Maryland Univ., College Park. Dept. of Physics and Astronomy
[STUDY ON THEORETICAL AND EXPERIMENTAL RESEARCH ON GRAVITATIONAL RADIATION] Progress Report
Joseph Weber Jun. 1965 3 p refs
(Grant NsG-436)
(NASA-CR-63768) CFSTI: HC $1.00/MF $0.50 CSCL 9E

Two types of closed loop servosystems for the LaCoste Romberg gravimeter were completed and three instruments are now operating. This system is believed to meet the performance requirements of the Apollo gravitational experiment, provided suitable repackaging is completed to meet flight specifications. Calculations were continued on gravimeter arrangements permitting the kind of temperature control required. Indications are that an instrument mounted in a reflector which exchanges energy with the cold sky and is never exposed to the sun may be satisfactory. R.W.H.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-26803# Joint Publications Research Service, Washington, D. C.
SOVIET STUDIES ON ROENTGENOLOGY AND RADIOLOGY
17 Jun. 1965 18 p refs Transl. into ENGLISH from Vestn. Rentgenol. i Radiol. (Moscow), no. 6, 1964 p 60–66, 72–74
(JPRS-30672; TT-65-31285) CFSTI: $1.00

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2. THE EMPLOYMENT OF ADDITIONAL FILTERS TO DECREASE THE IRRADIATION DOSE IN ORDINARY ROENTGENOGRAPHY AND IN CERTAIN SPECIAL METHODS OF INVESTIGATION B. M. Aliyev and I. Ye. Rabkin p 10–15 (See N65-26805 16-04)

N65-26804 Joint Publications Research Service, Washington, D. C.
A METHOD OF CALCULATING ABSORBED DOSES OF LONG-WAVE X-RAYS
A. N. Krongauz and A. V. Frolova *In its* Soviet Studies on Roentgenol. and Radiol. 17 Jun. 1965 p 1–9 refs (See N65-26803 16-04) CFSTI: $1.00

The following parameters must be considered in choosing the optimal irradiation regime to provide the best therapeutic effect from calculated absorbed and integral absorbed radiation doses: (1) the regime of irradiation, indicating voltage production and filter; (2) the geometric conditions of irradiation; (3) the qualitative characteristics of irradiation determined by the half-value layer or by the effective energy of quanta; (4) the quantitative characteristics of irradiation generated by the X-ray tube; (5) the absorbed dose in the focus; (6) the distribution of the absorbed dose in surrounding tissues; and (7) the integral absorbed dose in the focus and in the entire body. Sample calculations for tumors located within or on the surface, respectively, of the integument are given. The size of the irradiation dose in this case is determined by clinical indexes depending on the histological structure of the tumor. G.G.

N65-26805 Joint Publications Research Service, Washington, D. C.
THE EMPLOYMENT OF ADDITIONAL FILTERS TO DECREASE THE IRRADIATION DOSE IN ORDINARY ROENTGENOGRAPHY AND IN CERTAIN SPECIAL METHODS OF INVESTIGATION
B. M. Aliyev and I. Ye. Rabkin *In its* Soviet Studies on Roentgenol. and Radiol. 17 Jun. 1965 p 10–15 (See N65-26803 16-04) CFSTI: $1.00

Aluminum filters of 1 mm and copper filters of 0.1 to 0.5 mm thickness were used as additional filters for ordinary roentgenography, for angiography, and for cinematography with an electron-optical converter to determine the relation between irradiation dosage and filtration of the primary beam. Studies on an osteo-paraffin phantom were compared with those carried

out directly on patients. Roentgenograms taken both with the use of additional filters and without them differed very little from each other, but the employment of additional filters increased the sharpness of the picture and the distinguishability of detail, especially in angiography. Analysis of dosimetric measurements established that additional filters significantly decreased the size of the discharge dose and, consequently, the overall radiation load on patients without significant change in the quality of the roentgenogram. G.G.

N65-26917# Joint Publications Research Service, Washington, D. C.
EFFECTS OF SPACE FLIGHT ON VARIOUS PHYSIOLOGICAL FUNCTIONS
30 Jun. 1965 48 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 2, Mar.–Apr. 1965 p 169–187, 274–284
(JPRS-30859; TT-65-31379) CFSTI: $2.00

CONTENTS:

1. REACTIONS OF COSMONAUTS DURING PARABOLIC FLIGHT IN AIRCRAFT I. I. Kas'yan, I. A. Kolosov, V. I. Lebedev, and B. N. Yurov p 1–18 refs (See N65-26918 16-05)

2. THE DAILY RHYTHM OF VEGETATIVE FUNCTIONS DURING SPACE FLIGHT G. V. Altukhov, P. V. Vasil'yev, V. Ye. Belay, and A. D. Yegorov p 19–26 refs (See N65-26919 16-04)

3. OCULOMOTOR ACTIVITY IN COSMONAUTS DURING ORBITAL FLIGHTS I. T. Akulinichev, M. D. Yemel'yanov, and D. G. Maksimov p 27–33 refs (See N65-26920 16-05)

4. THE EFFECT OF ANGULAR AND CORIOLIS ACCELERATIONS ON CERTAIN FUNCTIONS OF THE HUMAN ORGANISM S. S. Markaryan p 34–45 refs (See N65-26921 16-04)

N65-26919 Joint Publications Research Service, Washington, D. C.
THE DAILY RHYTHM OF VEGETATIVE FUNCTIONS DURING SPACE FLIGHT
G. V. Altukhov, P. V. Vasil'yev, V. Ye. Belay, and A. D. Yegorov *In its* Effects of Space Flight on Various Physiol. Functions 30 Jun. 1965 p 19–26 refs (See N65-26917 16-04) CFSTI: $2.00

Presented is an analysis of the nature of changes in the daily rhythm of the heart rate and systolic index which in some measure reflect both the state of the cardiovascular system as well as the state of the entire organism. Emphasized are those features of the daily rhythm of physiological and particularly vegative functions which are induced during prolonged exposure to conditions of weightlessness. It is concluded that the mechanism for the disturbance of the daily rhythm of vegative functions is complex and probably related both to the specific effects of weightlessness as well as to neuroemotional tension. S.C.W.

N65-26921 Joint Publications Research Service, Washington, D. C.
THE EFFECT OF ANGULAR AND CORIOLIS ACCELERATIONS ON CERTAIN FUNCTIONS OF THE HUMAN ORGANISM
S. S. Markaryan *In its* Effects of Space Flight on Various Physiol. Functions 30 Jun. 1965 p 34–45 refs (See N65-26917 16-04) CFSTI: $2.00

The effects of angular accelerations at rotational speeds of 180, 360, 540, and 720 degrees/second; and the effects of coriolis accelerations at speeds of 180, 360, and 540 degrees/second; on the physiological responses of seated human subjects, were studied. Augmentation of the speed and duration of angular acceleration caused an increase in the duration of vestibular nystagmus and the illusion of counterrotation. During angular acceleration and shortly thereafter, there was a deterioration in the ability to discern dial indicators and signs. With augmentation of the speed, there was an increase in pulse and respiration frequency. Repeated angular acceleration lead to general fatigue, disturbances in stasis, and to vestibulo-vegetative disturbances in persons with moderate vestibular sensitivity. Following angular acceleration there was a slowing of the pulse, a reduction in maximal arterial pressure, and an increase in minimal arterial pressure. By altering the position of the head during rotation a displacement of surrounding objects was experienced. With repeated inclinations and increased rotational rates, the displacement effect was amplified and vestibulo-vegetative disturbances occurred more rapidly. S.C.W.

N65-26955# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine
AVIATION MEDICINE TRANSLATIONS: ANNOTATED BIBLIOGRAPHY OF RECENTLY TRANSLATED MATERIAL III
Mary Ellen Allen, William E. Collins, Jerry V. Tobias, and Ruth Ann Crain Apr. 1965 19 p refs
(AM-65-17)

An annotated bibliography of translations of foreign-language research articles is presented. The 26 listed entries are concerned with studies of aviation medicine, periodicity, optokinetic nystagmus, vision, vestibular function, and physical science. Procedures for obtaining copies of the translations are included. Author

N65-26956# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine
ADAPTATION TO VESTIBULAR DISORIENTATION. I: VERTIGO AND NYSTAGMUS FOLLOWING REPEATED CLINICAL STIMULATION
William E. Collins May 1965 17 p refs
(AM-65-18)

Forty unilateral caloric irrigations were administered in a habituation series to each of two groups of subjects. One group was tested in total darkness. Subjects in the second group were stimulated in illumination and actively attempted to control and suppress their eye movements by means of visual fixation. Pre- and post-tests were administered (always in total darkness) in which both directions of response were elicited. In all cases, tasks were assigned to subjects to maintain alertness. The nystagmic reaction was altered as a result of the habituation series, but the change was different for the two groups. After one month of rest, there was no apparent recovery of the response toward the pretest level for either group. Sensations of vertigo declined in intensity for both groups, but showed recovery after a one-month rest period. Author

N65-27025# Joint Publications Research Service, Washington, D. C.
ON THE SPECIFIC CHARACTER OF BIOLOGICAL STRUCTURES
M. F. Vedenov and V. I. Kremyanskiy 22 Jun. 1965 22 p Transl. into ENGLISH from Vopr. Filosofii (Moscow), no. 1, 1965 p 84–94
(JPRS-30737; TT-65-31306) CFSTI: $1.00

In attempting to develop a complete characterization of biological structure by distinguishing between living and nonliving systems, the concepts of regeneration, inheritance, locomotion, plasticity, adaptability, and systematic orderliness and partial disorderliness are discussed. J.M.D.

N65-27028# Joint Publications Research Service, Washington, D. C.

USE OF A GOLD–IRON ELECTRODE PAIR FOR THE ELECTROCHEMICAL RECORDING OF TISSUE OXYGEN IN VIVO

I. P. Berezin, I. M. Epshteyn, and L. A. Kashchevskaya 28 Jun. 1965 6 p refs Transl. into ENGLISH from Eksperim. Khirur. i Anesteziol. (Moscow), no. 3, May–Jun. 1964 p 18–19

(JPRS-30818; TT-65-31355) CFSTI: $1.00

An iron–gold pair of electrodes has been suggested for use both clinically and in experimental investigations because of their ability to register tissue oxygen tension. Experiments had been made with Au–Zn and Au–Fe electrodes, with the Au–Zn combination exhibiting more sensitivity. The method of covering the electrode with a gold layer is detailed, and the composition of the electrolyte used is given. The area of the iron electrode is 50 times that of the gold covering of the active electrode. To check the utility of the Au–Fe electrode pair, parallel measurements were made by chemical and electrochemical methods on the amount of dissolved O_2 in a 0.9% solution of NaCl after it had been boiled for 30 minutes, and in pure oxygen and air. It is also reported that an experiment done on the brain tissue of a rabbit breathing both pure O_2 and ordinary air reaffirms that the indicated pair of electrodes register tissue oxygen tension. The electrode pair studied can be used in various tissues and organs. M.W.R.

N65-27030# Joint Publications Research Service, Washington, D. C.

SOVIET RESEARCH ON THE EFFECTS OF VIBRATION

S. N. Sinitsin et al 29 Jun. 1965 13 p refs Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniya (Moscow), no. 3, Mar. 1964 p 3–10

(JPRS-30845; TT-65-31366) CFSTI: $1.00

Two studies dealing with the biochemical effects of vibration are presented. The first deals with the influence of generalized vibrations of varying amplitude on carbohydrate metabolism and adrenaline activity in rabbits. Four series of experiments were performed, each with a frequency of 50 cps: With an amplitude of 15μ, there were no changes in the animals. Exposures between 50μ and 100μ were associated with changes in the nature of the glycemic curves, whereas 200μ exposure was characterized by a drop in blood sugar and glycogen level as well as abnormal glycemic curves. When amplitude was raised to 800μ, there was marked decrease in blood sugar and an imbalance and drop in adrenaline activity. A study with shipyard workers suffering from vibration sickness showed their blood was low in 17-oxycorticocosteroid. Administration of ACTH usually did not bring about a change in 17-OCS content. It was concluded that decreased sensitivity of the adrenal cortex to ACTH is part of a general pattern of decreased sensitivity to external stimuli in persons suffering from vibration sickness. M.W.R.

N65-27033# Joint Publications Research Service, Washington, D. C.

TOXICOLOGICAL CHARACTERISTICS OF NEW RUBBER MIXTURE INGREDIENTS

R. S. Vorob'yeva and N. V. Mezentseva 29 Jun. 1965 8 p Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniya (Moscow), v. 8, no. 7, 1964 p 39–43

(JPRS-30850; TT-65-31371) CFSTI: $1.00

To provide information about the toxicity of synthesized vulcanizing substances, studies were made with dipac (D) and paraquinone dioxime (PD), two accelerants, and mercaptobenzimidazol (M), an antioxidant. The effect of these compounds on the general state of health, body weight, and oxidation processes of laboratory animals was investigated. Changes in the behavior and general condition of the animals were not noted, and the M was found to be more toxic than the other two compounds with oral doses and with subcutaneous inoculations. When inoculated, M made the animals sluggish, decreased body weights, increased the size of kidneys, and disturbed oxidation processes. Changes in the nervous system caused by M were considered to be transient and easily reversible. All three compounds had adverse effects on the lungs, and only toward the end of the experiment did they affect the protein formation function of the liver. General anemia was caused by M, and both M and PD disturbed prothrombin formation and caused hemorrhage. M.W.R.

N65-27037# Joint Publications Research Service, Washington, D. C.

THE USE OF SATAL, A BULGARIAN DRUG, AS A THERAPEUTIC AGENT IN INDUSTRIAL LEAD POISONING

V. Petkov, V. Stovev, D. Bakalov, and L. Petev 30 Jun. 1965 11 p refs Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniya (Moscow), no. 4, Apr. 1965 p 42-49

(JPRS-30863; TT-65-31382) CFSTI: $1.00

Satal, a drug containing garlic bulb substance, was found to have a statistically significant effect on reduction of lead poisoning symptoms in workers. This was attributed to the fact that part of the lead powder which enters the digestive tract combines with the active sulfur components in the garlic and is precipitated in the form of insoluble sulfides which are not resorbed by the body. Also, a large part of the polysulfides is eliminated through the respiratory system. Two Satal lozenges, each containing 0.25 grams of garlic bulb substance, were given three times a day to a group of workers who had definite symptoms of lead poisoning, determined by porphyrins in the urine and basophilogranular erythrocytes in the blood. A control group with the same symptoms was not given the drug, and both groups carried out all the preventive measures required by the factory. At the beginning of the study, the experimental and control groups had approximately the same porphyrin counts, whereas at the end of period there was a significantly lower count for those taking the drug. The same was found for erythrocyte count. M.W.R.

N65-27062*# Nuclear Science and Engineering Corp., Pittsburgh, Pa.

A STUDY OF THE ROLE OF RADIOACTIVITY AND HYDROTHERMAL PROCESSES IN PROTOBIOCHEMISTRY

R. L. Bogner, S. L. Hood, E. R. White, and S. Somani Jun. 1965 70 p refs

(Contract NASw-989)

(NASA-CR-63560; NSEC-118) CFSTI: HC $3.00/MF $0.75 CSCL 06A

This report describes the initial phases of a study designed to test the novel and unique hypothesis that organic synthesis and chemical evolution in primitive planetary environments may have proceeded in radioactive hydrothermal systems. It was demonstrated that an abundance of biochemically significant organic compounds can be formed from the simplest chemical resources in hot, aqueous environments under the influence of ionizing radiation. Furthermore, it was shown that high-molecular weight peptides and proteinoids can be produced in the same unique model system thus providing mechanisms for the generation of macromolecules, an essential development for the evolutionary progression from chemical simplicity to prebiotic molecular complexity. This experimental verification of the possible geological origin of biochemical substances (chemical abiogenesis) suggests that spontaneous primordial chemical reactions might well have led to the production and proliferation of organic molecules in favorable local environments, e.g. hot springs, early in the history of the planet Earth. These ground-based studies assume an immediate significance for lunar and planetary exploration in view of the fact that propitious geochemical events and conditions on the moon and Mars, similar to those present earlier in the history of the

Earth, may provide primitive hydrothermal radioactive systems in which abiogenic formation of extraterrestrial organic compounds proceeds at present. Author

N65-27066# Joint Publications Research Service, Washington, D. C.
CONSTANT OF ION DISAPPEARANCE AND ITS HYGIENIC SIGNIFICANCE
V. F. Kirillov 29 Jun. 1965 6 p refs Transl. into ENGLISH from Gigiena i Sanit. (Moscow), no. 4, Apr. 1964 p 96–97
(JPRS-30842; TT-65-31363) CFSTI: $1.00

The number of light ions in the air of rooms is proposed as an indirect index of its hygienic quality. Since the index cannot be used in practice because of the impossibility of standardizing it, a practical index was sought. The equilibrium level of ionization (number of light ions in air) is postulated to depend on the intensity of ion formation and the rate of the process of ion destruction (disappearance constant). The disappearance constant theoretically can be used for characterizing the sanitary-hygienic degree of atmospheric purity. An experiment was conducted to verify the theoretical considerations. A ventilation setup with air recirculation was used. Tabulated results of the air ionization level, rate of ion formation, and disappearance constant are presented. The experimental results were thus far inconclusive, and the hygienic significance of the index also remains inconclusive. L.S.

N65-27067# Joint Publications Research Service, Washington, D. C.
CHEMISTRY AND SURGERY
B. V. Petrovskiy 30 Jun. 1965 16 p Transl. into ENGLISH from Priroda (Moscow), no. 3, 1965 p 16–24
(JPRS-30864; TT-65-31383) CFSTI: $1.00

The use of alloplastics in reconstructive and restorative surgery as well as in general surgical practice is discussed from a clinical point of view. The art of alloplastic surgery makes use of a multitude of polymers, including polyvinylalcohol sponges, capron fabrics, and other synthetic materials which can be accommodated or absorbed by the body. Mention is also made of gauze polymers treated with amino acids, flaps of fluoroplastic fabric for heart surgery, and plastic tubes and prostheses. M.W.R.

N65-27115# Joint Publications Research Service, Washington, D. C.
THE INFLUENCE OF INTEROCEPTIVE AFFERENTATION UPON EXCITATION OF THE VOMITING CENTER DURING MOTION SICKNESS
I. D. Pestov 29 Jun. 1965 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 5, Sep.–Oct. 1964 p 690–694
(JPRS-30843; TT-65-31364) CFSTI: $1.00

The role of extralabyrinthine influences in the pathogenesis of motion sickness was studied. Apomorphine was administered to both intact and labyrinthectomized dogs for inducing excitability in the vomiting center, while irregularly rotating the dogs at speeds of 10 rpm to 16 rpm. By varying dosages and rotation speeds, and by measuring effective times of threshold dosages, the interceptive afferentation originating from the organs of the abdominal cavity was assessed. Results indicate that vestibular afferentation is the cause of increased excitability of the vomiting at rotation rates of 10 rpm, and that, with increasing rates of 12, 14, and 16 rpm, extralabyrinthine afferent influences on the vomiting center originate from the interocaptors of the abdominal cavity. Experiments using intraperitoneal novocaine anesthesia also support the conclusions. L.S.

N65-27136 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RESULTS OF STUDY OF THE BIOLOGICAL EFFECTIVENESS OF A NUMBER OF SPACE-FLIGHT FACTORS
V. V. Parin, V. V. Antipov, B. I. Davydov, E. F. Panchenkova, G. A. Chernov et al *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 221–240 refs Presented at the 15th Intern. Congr. on Astronautics, Warsaw, 7 Sep.–12 Oct. 1964 (See N65-27125 16-13)

Experimental data on the biological effectiveness of a number of factors in space flight (vibration, acceleration, ionizing radiation; the combined action of radiation with dynamic spaceflight factors), as evaluated from the changes in the serotonin and ceruloplasmin contents in the blood of mice, rats, guinea pigs, dogs and monkeys, are presented. The results obtained indicate that these methods are sensitive in evaluating the reactivity state of the animals under subjection to spaceflight factors. Author

N65-27244 Joint Publications Research Service, Washington, D. C.
THE PROPAGATION OF EXCITATION IN ONE-DIMENSIONAL STRUCTURES
B. R. Telesnin *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 219–229 refs (See N65-27225 16-34) CFSTI: $6.00

Continued studies of one-dimensional structures of homogeneous excited tissues which focus on the propagation of excitation along a segment of a line during periodic excitation of its edge, are reported. Presented are results of an analytical and experimental investigation of the stability of different arrangements of pulses in a ring, using discrete models constructed with a digital computer. The influence of the initial conditions on the propagation of excitation in lattice structures of homogeneous tissue was also examined. S.C.W.

N65-27267# Joint Publications Research Service, Washington, D. C.
STUDIES IN NUTRITION
8 Jun. 1965 28 p refs Transl. into ENGLISH from Vopr. Pitaniya (Moscow), v. 24, no. 2, Mar–Apr. 1965 p 3–7, 40–46, 89–91
(JPRS-30497; TT-65-31208) CFSTI: $2.00

CONTENTS:

1. ANTIMICROBIAL PROPERTIES OF SOME TROPICAL AND SUBTROPICAL FRUIT S. I. Zelepukha p 1–9 refs
2. INVESTIGATION OF INDICES OF METABOLISM OF SOME VITAMINS IN THE ORGANISM OF DOGS FED ON MEAT PRODUCTS SUBJECTED TO THE EFFECT OF PASTEURIZING DOSES OF GAMMA-RADIATION Yu. I. Shillinger, V. G. Kachkova, and N. B. Maganova p 10–19 refs (See N65-27268 16-04)
3. UKRAINIAN REPUBLIC CONFERENCE OF PHYSICIANS ON HYGIENE OF NUTRITION IN CONNECTION WITH THE USE OF POISONOUS CHEMICALS IN AGRICULTURE G. V. Gracheva p 20–25

N65-27268 Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF INDICES OF METABOLISM OF SOME VITAMINS IN THE ORGANISM OF DOGS FED ON MEAT PRODUCTS SUBJECTED TO THE EFFECT OF PASTEURIZING DOSES OF GAMMA-RADIATION
Yu. I. Shillinger, V. G. Kachkova, and N. B. Maganova *In its* Studies in Nutr., 8 Jun 1965 p 10–19 refs (See N65-27267 16-04) CFSTI: $2.00

The effect on animal metabolism of radiolabile vitamins due to radiating dietary meat was studied. For an 18-month period, dogs were fed beef and pork products irradiated with pasteurizing doses of gamma radiation; a control group fed on non-irradiated meat was maintained during the same period. The radiation appeared to cause no deficiency of thiamine, pyridoxine, and vitamins E and K in the experimental dogs, and no difference in variability of the vitamin indices was observed between the experimental and control groups. J.M.D.

N65-27419# Library of Congress, Washington, D. C. Aerospace Technology Div.
SECOND INTERNATIONAL SYMPOSIUM ON BASIC ENVIRONMENTAL PROBLEMS OF MAN IN SPACE
23 Jun. 1965 18 p Meeting held at Paris, 14–18 Jun. 1965 *Its* Special Issue, Vol. 3, No. 253

Basic environmental problems of man in space are presented and include biomedical studies on Voskhod 1, the effect of combined space flight factors on the functions of an organism, prolonged exposure to a pure oxygen atmosphere, radiation safety on long flights, Vostok and Voskhod life support systems, sensory activity and space physiology, and man–machine system reliability. R.N.A.

N65-27425# Joint Publications Research Service, Washington, D. C.
SOVIET RESEARCH ON INSOLATION
9 Jun. 1965 18 p refs Transl. into ENGLISH from Vopr. Kurortol., Fizioterapii i Lecheb. Fiz. Kul't. (Moscow), no. 2, Mar.–Apr. 1964 p 104–112
(JPRS-30527; TT-65-31225) CFSTI: $1.00

CONTENTS:

1. THE INFLUENCE OF INSOLATION OF THE COLLAR ZONE ON CONDITIONED REFLEX ACTIVITY AND ARTERIAL PRESSURE OF ANIMALS V. A. Baronenko p 1–8 refs (See N65-27426 16-04)
2. THE INFLUENCE OF INSOLATION ON RESPIRATION V. A. Gamburtsev p 9–15 (See N65-27427 16-04)

N65-27426 Joint Publications Research Service, Washington, D. C.
THE INFLUENCE OF INSOLATION OF THE COLLAR ZONE ON CONDITIONED REFLEX ACTIVITY AND ARTERIAL PRESSURE OF ANIMALS
V. A. Baronenko *In its* Soviet Res. on Insolation 9 Jun. 1965 p 1–8 refs (See N65-27425 16-04) CFSTI: $1.00

1. A series of daily solar irradiation of the collar zone in doses from 3 to 24 cal (24 procedures) elicits changes in conditioned reflex activity and arterial pressure dynamics of healthy rabbits. 2. The effect of insolation is phasic. It first elicits a phase of excitation that lasts for 24 hours, then a prolonged phase of inhibition (up to one week), and then a stable phase of normalization of conditioned reflex activity. 3. During the phases of excitation and inhibition of conditioned reflexes the animals revealed significant elevation of arterial pressure, lasting for seven to ten days. And during the phase of normalization of conditioned reflexes the pressure drops and becomes stabilized. 4. The phasic nature of changes in conditioned reflex activity is related to the typological features of the animals, but this cannot be said of the arterial pressure which is in closer relationship with the functional state of the central nervous system. 5. Insolation of the collar zone (in small doses) ultimately has a stimulating effect on conditioned reflex activity and causes a persistent drop (within normal range) in arterial pressure. This effect is more pronounced in animals of the strong type. Author

N65-27427 Joint Publications Research Service, Washington, D. C.
THE INFLUENCE OF INSOLATION ON RESPIRATION
V. A. Gamburtsev *In its* Soviet Res. on Insolation 9 Jun. 1965 p 9–15 (See N65-27425 16-04) CFSTI: $1.00

A study on the influence of sun baths on voluntary changes in respiration, which focuses on establishing effective methods of gaging sun baths in the presence of pathophysiological diseases, is reported. It is shown that voluntary respiratory excursions of the chest distinctly reflect the physical condition during sun baths. The influence of solar radiation on this index varies according to sex, age, and the physical condition of individuals. An increase in the number of sun baths is paralleled by an increase in duration of the phase of intensified function: the body becomes gradually conditioned to the effect of solar radiation. Persons who are highly sensitive to the sun, particularly in the presence of nervous and cardiovascular diseases, reveal a marked decrease in duration of the phase of intensified function during sun baths. Results confirm the selection of sun bath doses determined at resorts, and allow determination of the dosage and duration of solar therapy courses for individuals and groups of patients. S.C.W.

N65-27447# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
ANALYSIS OF EXTERNAL RADIATION EXPOSURES IN 1964
G. Cowper and P. C. Rowe Feb. 1965 18 p refs
(AECL-2239) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

An analysis of occupational radiation exposures received by workers at AECL in 1964 has been carried out by machine accounting methods. Results are presented in tables and graphs. Author

N65-27468# Atomic Energy Commission, Washington, D. C. Div. of Biology and Medicine.
LATE IRRADIATION EFFECTS CONFERENCE: INVENTORY OF CAPABILITY
Paul S. Henshaw, ed. May 1965 329 p refs Sum. of proc. of conf. held at Germantown, Md., 4–6 Dec. 1963
(WASH-1059) CFSTI: $4.50

Proceedings of the conference were summarized to indicate criteria used to investigate late irradiation effects, to consider the character of radiation-induced degenerative changes and relate them to natural aging processes, and to suggest future directions for research. The problem was defined and manifestations of late radiation effects were discussed in terms of the whole organism, tissues, and cells and biochemical changes. Similarity between late effects and the signs and symptoms of normal aging, the relationship between irradiation and degradative change, and prenatal irradiation and later life vigor were also discussed. Other topics reviewed by the conference participants include *Capability Reserves and Subclinical Effects; Biologic Organization and Degradative Change;* and *The Nature of Irreparable Radiation Injury*. Suggestions for future research were aimed at finding more precise data on histopathological changes with age, tumor incidence and its relation to dosage, and means of counteracting degradative trends. M.W.R.

N65-27471# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
MEASUREMENT OF THE DOSE ABSORBED IN VARIOUS ORGANS AS A FUNCTION OF THE EXTERNAL GAMMA RAY EXPOSURE

A. R. Jones Oct. 1964 21 p refs
(AECL-2240) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

An average man phantom, containing all bones of the head and trunk, was irradiated from in front, behind and rotationally with gamma rays of various energies. The exposure at sites within and on the surface of the phantom were measured with lithium fluoride dosimeters. Also the exposures at the same points in space were similarly measured in the absence of a phantom. Among sites chosen were the gonads, representative points in the red bone marrow and the usual film badge positions. From the measured ratio of the internal and external exposure the absorbed dose at important sites was computed as a function of external exposure for gamma rays of varying energy and direction. Author

N65-27513*# Naval School of Aviation Medicine, Pensacola, Fla.
VISUAL ILLUSIONS OF MOVEMENT
Thomas C. D. Whiteside, Ashton Graybiel, and Jorma I. Niven 21 Oct. 1963 19 p refs Joint Report with NASA Its Rept.-90
(NASA Order R-93)
(NASA-CR-63651; NSAM-877; FPRC-1207) CFSTI: HC $1.00/MF $0.50 CSCL 06P

The autokinetic, oculogyral, and oculogravic illusions all involve apparent motion or displacement of the visual field with respect to an observer. It is shown that these illusions are related to involuntary eye movements, occurring either spontaneously as in the autokinetic illusion, or in response to the special stimuli associated with the other two illusions. During fixation the visual sensation of movement seems to be produced by, or related to, the pattern of efferent activity aimed at the group of extraocular muscles which will act as antagonists to the involuntary eye movement referred to. Author

N65-27517*# Army Biological Labs., Fort Detrick, Md. Physical Defense Div.
DRY HEAT STERILIZATION OF MICROORGANISMS AT 105°C
Dorothy M. Portner 7 Jun. 1965 5 p refs
(NASA Order R-35)
(NASA-CR-63665) CFSTI: HC $1.00/MF $0.50 CSCL 06M

The effectiveness of dry heat at 105° C (221° F) against different levels of microbial contamination on glass surfaces, either embedded or not embedded in plastic, was investigated. Limited tests were run at 105° C and those which were performed were done with spores on exposed surfaces or organisms in soil. No death rates were determined on organisms embedded in plastic. The reason for conducting further studies at this low temperature was that Dr. Imshenetsky indicated the Russian spacecraft would be sterilized by exposure to 105° C for a few days. This temperature is considerably lower than any temperature NASA has considered for dry heat sterilization of space probes. Therefore, the investigation reported here was undertaken to obtain more information on the effectiveness of dry heat sterilization at this lower temperature. Author

N65-27526# Mason Research Inst., Worcester, Mass. Dept. of Immunology
ANTIGEN-ANTIBODY RESPONSES IN THE RHESUS MONKEY. FREEZE-PRESERVATION OF RHESUS MONKEY ERYTHROCYTES Progress Report
Arthur E. Bogden [1965] 20 p refs
(Contract AF 41(609)-2667)
(AD-465702)

The effect of freeze-preservation and subsequent thawing on Rhesus erythrocytes was studied comparing three endocellular cryophylactic agents (ECA) glycerol, propylene glycol, and dimethylsulfoxide. Cellular destruction, cellular morphology, and specific hemagglutinability were used as parameters for successful freeze-preservation. Propylene glycol was a satisfactory ECA in respect to minimal cellular destruction (5%), as well as to the other parameters studied. Dimethylsulfoxide was very hemolytic to Rhesus erythrocytes directly upon mixing; 85% of the erythrocytes were destroyed. Erythrocytes mixed with glycerol showed less cellular destruction before and after freezing and thawing. However, such cells had an altered morphology, were variable in their agglomerability in glucose-fructose solutions, and hemolyzed upon resuspension in buffered isotonic salt solution. Hemagglutination reactions with cells frozen in propylene glycol and aged for 24 hours in buffered saline were strong and clear cut with evidence of a prozone and a definite negative end-point. Good serologic reactivity of such cells persisted over the 8 day study period. R.N.A.

N65-27531# Bryn Mawr Coll., Pa. Dept. of Biology.
EFFECT OF COLD ON BLOOD CLEARANCE OF CARBON AND BACTERIA OF DIFFERENT VIRULENCE
L. Joe Berry and Dorothy S. Smythe Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Jan. 1965 18 p refs
(Contract AF 41(609)-1764)
(AAL-TDR-64-14; AD-615010)

Mice singly housed without bedding at 5° C cleared carbon from the blood more slowly than animals similarly housed at 25° C. Increasing the time of exposure to cold to 2, 18 or 72 hours does not further alter the rate of clearance. Bacteria are also "cleared" uniformly at the two temperatures when a highly virulent strain (SR-11) of *Salmonella typhimurium* is injected intravenously, but not when one of low virulence (RIA) is used. The RIA strain disappears from blood more slowly in mice at 5° C than in those at 25° C. This was demonstrated both by dilution counts and by labeling the bacteria with P^{32} and following the decline in radioactivity of blood with time. Livers of mice were sampled at times postinfection for radioactivity and for viable bacterial counts. Housing temperature had no effect on radioactivity changes, but viable counts were higher and decreased more slowly in mice at 5° C than at 25° C. These findings are believed to account, in part, for the greater susceptibility to infection with RIA that was previously seen in mice exposed to cold compared to those at 25° C. Author

N65-27544 Chicago Univ., Ill.
STUDY OF MONKEY, APE, AND HUMAN MORPHOLOGY AND PHYSIOLOGY RELATING TO STRENGTH AND ENDURANCE. PHASE IV: THE MUSCULOSKELETAL ANATOMY OF THE THORAX AND BRACHIUM OF AN ADULT FEMALE CHIMPANZEE
William E. Edwards Holloman AFB, N. Mex., Aeromed. Res. Lab. (6571st), Apr. 1965 47 p refs
(Contract AF 29(600)-3466)
(ARL-TR-65-3; AD-615561)

The left thoracic and brachial musculature of a young-adult female chimpanzee is described and illustrated with the accuracy of detail plus clarity made possible by the photo-etching process. Other data are depicted graphically by section drawings. Comparisons with data from the literature on other chimpanzees, apes, humans, and non-hominoid primates are also provided, with emphasis on quantitative aspects. Author

N65-27561# American Foundation for Biological Research, Madison, Wis.
THE DISTRIBUTION OF ICE IN FROZEN TISSUES OF FROGS AND MICE
B. J. Luyet, M. Ross, P. M. Gehenio, J. Nath et al Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Dec. 1964 36 p refs
(Contract AF 41(657)-343)
(AAL-TDH-63-28; AD-615009)

Distribution of ice was observed in the frozen organs of animals. Various tissues and organs were excised from freshly killed frogs and mice, and were frozen at temperatures from −1 to −5° C. Sections were photographed in the frozen state, and during and after thawing. The ice distribution observed in skin, digit, mesentary, blood vessel, intestine, liver, lung, and heart sections are presented with discussion. J.M.D.

N65-27567# Tactical Air Command, Langley AFB, Va.
OPERATIONAL TEST AND EVALUATION—EXPOSURE SUIT, CWU-10/P Final Report
Wayne E. Williams and Clifford J. Whitham, Jr. Jan. 1964 12 p
(TAC-TR-63-31(D); AD-428692)

The CWU-10/P Anti-exposure Coverall was evaluated to determine its overall suitability. The tests revealed that the coverall did have some improvements over previous types but is unacceptable in that it does not provide adequate protection for the extremities during immersion in cold water. Other deficiencies were revealed that will require correction before the CWU-10/P can be considered a suitable anti-exposure coverall. Author

N65-27575# Ohio State Univ., Columbus. Div. of Occupational Medicine.
ACUTE HEPATOTOXICITY AND ENZYMATIC RESPONSE TO HYDRAZINE AND 1,1-DIMETHYLHYDRAZINE IN RATS
Charles F. Reinhardt and Mildred K. Pinkerton (AMRL) Wright-Patterson AFB, Ohio, AMRL, Feb. 1965 39 p refs
(Contract AF 33(657)-1698)
(AMRL-TR-65-19; AD-614587)

The in vivo and in vitro effects of hydrazine and of 1,1-dimethylhydrazine (UDMH) on blood serum and liver tissue enzyme activities were studied. The specific enzymes investigated were lactic dehydrogenase, isocitric dehydrogenase, malic dehydrogenase and glutamic acid dehydrogenase. Activity levels were determined at 16, 24, 48 and 72 hours after intraperitoneal administration of the toxic agents to rats. Attempts were made to correlate enzyme levels with altered liver pathology. Results were compared with a concomitant study of the effects of carbon tetrachloride on the same enzymes and on liver pathology. Results indicated that the mechanisms of toxic action for these three chemical agents are probably dissimilar and that serum enyzme levels may not provide sensitive indications of altered liver pathology in the case of hydrazine or UDMH. Author

N65-27586# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COSMIC HORIZONS OF ANABIOSIS
N. Timofeyev 30 Mar. 1965 9 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 2, 1964 p 54–57
(FTD-TT-65-72/1 + 2; AD-614394)

A popularized article on hibernation of space crews as a method for making long space flights is presented. TAB

N65-27607# Southern Interstate Nuclear Board, Atlanta, Ga.
STUDY OF APPLICABILITY OF RADIATION PASTEURIZATION OF FRUITS IN THE SOUTH, MARCH 1–SEPTEMBER 1, 1964
Buford B. Ruhl 15 Sep. 1964 113 p refs
(Contract AT(38-1)-368)
(TID-21710) CFSTI: $4.00

Pasteurization of fruits by irradiation for reducing spoilage and for extending their marketable life, and the future applications of this technology to the South's fruit industries was studied. Postharvest physiology, wholesomeness, safety, spoilage rates, demand, and selected irradiation costs for oranges, grapefruits, tomatoes, peaches, and strawberries are considered. Tables, graphs, and maps showing fruit origin and destination regions are included. L.S.

N65-27609 Joint Publications Research Service, Washington, D. C.
ISOTOPES—EFFECTIVE TOOLS OF MODERN MEDICINE
Shih-chen Wang *In its* Transl. on Communist China's Sci. and Technol. 11 Jun. 1965 p 1–8 Transl. into ENGLISH from K'o-hsueh Ta-chung (Peiping), no. 4, Apr. 1965 p 3–5 (See N65-27608 16-34) CFSTI: $1.00

The uses of isotopes in the various fields of clinical, preventive, and general medicine are discussed. Isotopes are used in the examination and diagnosis of disease in the intestinal tract and liver. They can determine the fluid content of the body. Isotopes have definite characteristics and by analyzing the spectrum of a substance, elements can be identified and their proportions determined. This method can be used to determine the content of inorganic constituents in the blood stream. Isotopes can destroy malignant tumors and cancerous tissue. Dermatologists use isotopes to treat surface tumors and skin diseases. Bone cancer and leukemia can be treated by radioactive phosphorus, and radioactive colloidal gold is used to treat ascites and pleural effusion. Radioactive iodine is used to treat overactive thyroids and malignant thyroid tumors. Isotopes have an enormous potential in the field of sterilization. Their greatest contribution is their use as a research tool to study the phenomena of life and the causes of disease. R.N.A.

N65-27637# Tactical Air Command, Langley AFB, Va.
OPERATIONAL TEST AND EVALUATION HELMET, FLYING TYPE HGU-15/P
John N. Ewbank Mar. 1964 27 p
(TAC-TR-63-31(H); AD-435604)

The HGU-15/P Flying Helmet was evaluated under operational conditions to determine its overall suitability and aircrew acceptability. The helmet was flown in F-4B, F-105D and F-104C aircraft for a total of 41 sorties. The HGU-15/P Helmet did perform as designed but is unsatisfactory for use by aircrews during all tactical operations. It would probably produce dangerous fatigue and discomfort during flights of long duration as this factor was apparent on flights of only 1–2 hours. The helmet had poor aircrew acceptability due to the increased weight, restrictions to head movement, distractions from reflections and no dilute-demand regulator necessitating continuous 100% oxygen. The helmet did provide a significant improvement in outside noise attenuation. Author

N65-27676*# National Aeronautics and Space Administration, Washington, D. C.
ON THE VARIATION OF STRENGTH DURING MOVEMENT [UBER DIE VERANDERUNG DER KRAFT WAHREND DER BEWEGUNG]
J. H. O. Reijs May 1965 38 p refs Transl. into ENGLISH from Arch. Ges. Physiol. (Berlin), v. 191, 1921 p 234–257
(NASA-TT-F-9339) CFSTI: HC $2.00/MF $0.50 CSCL 06S

The significance of measurements of variations in strength during movement with respect to remedial exercises, design of artificial limbs, etc., is first discussed. The author describes a dynamometer for measuring strengths of various muscles in terms of a weighted pendulum, and problems associated with statistical variations due to physiological conditions such as fatigue. Extensive tests of hand grip and strength of the back muscles are then given for 2,000 people of both sexes, and ages from 6 to 60 years and are found to agree well with those of Quetélet and Dementjeff. The relation of the strength of the left hand to lefthandedness is examined for both men and women. Author

N65-27686*# National Aeronautics and Space Administration, Washington, D. C.

RELATION OF LENGTH OF CARDIAC CYCLE PHASES AND RATE OF PRESSURE CHANGE IN RIGHT AND LEFT VENTRICLES [SOOTNOSHENIYE DLITEL'NOSTI FAZ SERDECHNOGO TSIKLA i SKOROSTI IZMENENIYA DAVLENIYA v PRAVOM i LEVOM ZHELUDOCHKAKH]

Ye. B. Babskiy (Acad. of Sci. Ukrain. SSR), V. S. Sal'manovich, and I. L. Kosharskaya May 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 161, no. 4, 1965 p 986–988

(NASA-TT-F-9384) CFSTI: HC $1.00/MF $0.50 CSCL 06P

The purpose of the present study is to study the time structure of the systole in the right and left ventricles and to establish a coordination between the operation of these divisions throughout the cardiac cycle. Experiments were conducted on 50 dogs. It is found that the rate of pressure rise and fall in the left ventricle is several times higher than in the right. Author

N65-27709*# National Aeronautics and Space Administration, Washington, D. C.

SOME RESULTS OF MEDICAL INVESTIGATIONS CARRIED OUT DURING THE FLIGHT OF VOSKHOD [NEKOTORYYE REZUL'TATY MEDITSINSKIKH ISSLEDOVANIY, PROVEDENNYKH VO VREMYA POLETA KORABLYA "VOSKHOD"]

P. V. Vasil'yev and Yu. M. Volynkin Jun. 1965 24 p refs Transl. into ENGLISH from paper presented at 2d Intern. Symp. on Basic Environ. Probl. of Man in Space, Paris, 14–18 Jun. 1965 p 1–23

(NASA-TT-F-9423) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Results of medical investigations by telemetry and portable instrumentation in the Voskhod flight are summarized. Physiological reactions of cosmonauts with reference to flight stages are analyzed and their origins hypothesized. The lack of pathologic reactions is stressed. Author

N65-27711*# National Aeronautics and Space Administration, Washington, D. C.

EFFECTS OF THE COMBINED STRESSES OF SPACE FLIGHT ON CERTAIN BODY FUNCTIONS [KOMBINIROVANNOYE VOZDEYSTVIYE FAKTOROV KOSMICHESKOGO POLETA NA NEKOTORYYE FUNKTSII ORGANIZMA]

G. M. Frank, N. N. Livshits, M. A. Arsen'yeva, Z. I. Apanasenko, L. A. Belyayeva et al Jun. 1965 51 p refs Transl. into ENGLISH from paper presented at 2d Intern. Symp on Basic Environ. Probl. of Man in Space, Paris, 14–18 Jun. 1965

(NASA-TT-F-9425) CFSTI: HC $3.00/MF $0.50 CSCL 06S

The effect of space flight factors, acceleration, vibration, ionizing radiations, and the complex action of dynamic and radiation factors on some functions and oxidation metabolism of the central nervous system are considered. The combined effect of these factors on cell division in hematopoietic tissues, as well as the effect of acceleration on cerebral blood flow are studied. The variety and complexity of the results of combined dynamic and radiation factors stem from numerous combined action mechanisms. The oxygen effect on the processes of cell division and on the reactions of the central nervous system cannot be ignored. Such factors as protective inhibition, parabiotic phenomena, origin of dominant foci, play a significant part in the central nervous system reactions to combined action. Author

N65-27712*# National Aeronautics and Space Administration, Washington, D. C.

SOME ASPECTS OF SENSORY ACTIVITY AS APPLIED TO PROBLEMS IN SPACE PHYSIOLOGY [NEKOTORYYE VOPROSY DEYATEL'NOSTI SENSORNYKH SISTEM PRIMENITEL'NO K ZADACHAM KOSMICHESKOY FIZIOLOGII]

V. D. Glezer, V. A. Kislyakov, V. A. Kozhevnikov, V. N. Chernigovskiy, and L. A. Chistovich Jun. 1965 24 p Transl. into ENGLISH of paper presented at 2d Intern. Symp. on Basic Environ. Probl. of Man in Space, Paris, 14–18 Jun. 1965

(NASA-TT-F-9426) CFSTI: HC $1.00/MF $0.50 CSCL 05H

Orientation in space and recognition of visual images and speech sounds are considered in relation to obtaining and processing information from manned space flights. The role of the astronaut in the information processing system is shown schematically. Diagrams are included to show the operation of the receptive fields of the retina and to indicate the relationship between the amount of information obtained by an observer and the time required for information processing after recognition of variously oriented lines and pictures of objects. The relationship between discrimination of 3-element sequences and duration of constituent sounds is also presented. It is concluded that it is unrealistic to assume that an artificial system of movements can be devised to transmit at the same rate as the speech organs, and that voice communication is the most promising method of transmitting information from the astronaut to the machine. M.W.R.

N65-27713*# National Aeronautics and Space Administration, Washington, D. C.

EFFECTS ON THE ORGANISM OF PROLONGED EXPOSURE (100 DAYS) TO PURE OXYGEN AT A GENERAL PRESSURE OF 198 mm Hg [VLIYANIYE NA ORGANIZM DLITEL'NOGO PREBYVANIYA (100 SUTOK) V ATMOSFERE CHISTOGO KISLORODA PRI OBSHCHEM DAVLENII 198 MM RT. ST.]

N. A. Agadzhanyan, Yu. P. Bizin, G. P. Doronin, A. G. Kuznetsov, and A. R. Mansurov Jun. 1965 14 p refs Transl. into ENGLISH of paper presented at 2d Intern. Symp. on Basic Environ. Probl. of Man in Space, Paris, 14–18 Jun. 1965 13 p

(NASA-TT-F-9427) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Effects of various artificial atmospheres, with reduced total pressure and normal O_2 content, are examined. Pure O_2 atmospheres are tested with 148 white rats for 100 days at 198 mm Hg. Effects on reflexes, reaction to stimuli, and physical and cardiac changes are discussed. Author

N65-27715*# National Aeronautics and Space Administration, Washington, D. C.

RADIATION SAFETY CRITERIA FOR PROLONGED SPACEFLIGHTS [KRITERII RADIATSIONNOY BEZOPASNOSTI DLITEL'NYKH KOSMICHESKIKH POLETOV]

Yu. G. Grigoryev, Ye. Ye. Kovalev, A. V. Lebedinskiy, Yu. G. Nefedov, V. G. Vysotskiy et al Jun. 1965 24 p refs Transl. into ENGLISH of paper presented at 2d Intern. Symp. on Basic Environ. Probl. of Man in Space, Paris, 14–18 Jun. 1965 32 p

(NASA-TT-F-9209) CFSTI: HC $1.00/MF $0.50 CSCL 06R

The authors discuss types of radiation, their energy, the dimensional dose distributions, and the RBE of ionizing radiations to be found in an Earth-lunar trajectory. The organization of a spaceflight radiation safety system is presented. Author

N65-27724*# National Aeronautics and Space Administration, Washington, D. C.
TRANSFORMATION OF AMINO-ACYL-s-RNA INTO DIPEPTIDYL-s-RNA BY MEANS OF A WATER-SOLUBLE CARBODIIMIDE [PREVRASHCHENIYE AMINOATSIL-s-RNK V PEPTIDIL-s-RNK PRI POMOSHCHI VODORASTVORIMOGO KARBODIIMIDA]
V. K. Altunina, S. N. Zagrebel'nyy, and D. G. Knorre Jul. 1965 15 p refs Transl. into ENGLISH from Biokhimiya (USSR), v. 30, no. 1, 1965 p 189–194
(NASA-TT-F-9448) CFSTI: HC $1.00/MF $0.50 CSCL 06A

A study was carried out of the interaction between s-RNA from baker's yeasts and the acylating agent obtained from p-toluene sulphonate of N-cyclohexyl-N[β-(N-methylmorpholinium)]-ethylcarbodiimide and from formylamino acids. It was shown that under the conditions used C^{14}-valyl-s-RNA is transformed into formylglycylvalyl-C^{14}-s-RNA with a yield of 70%. Under similar conditions deacylated s-RNA combines with 7% C^{14}-formylalanine. No inactivation of s-RNA with regard to incorporation of C^{14}-valine by aminoacyl-s-RNA-synthetases from rat liver was noted. Author

N65-27748# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET LITERATURE ON LIFE SUPPORT SYSTEMS. PART A: BIOSCIENCES Surveys of Soviet-Bloc Scientific and Technical Literature
30 Dec. 1964 18 p refs Compilation of abstracts
(ATD-P-64-66; AD-609827)

Selected articles from the Soviet open liteature are reviewed under three general headings: space medicine and biology, space physiology, and space vehicle ecology. In the first section are included overviews of acheivements in space medicine and in the natural and social sciences. Space physiology articles are concerned with: 1) effect of high temperature and insolation on mineral salt content of body fluids; 2) distribution of body water in animals under various temperatures; 3) use of synthetic compounds to increase heat resistance of the body; and 4) changes in carbohydrate metabolism under conditions of total body vibration. An article dealing with the photosynthesis of *Chlorella vulgaris* Beyer in open-tank mass culture is reviewed in the ecology section. M.W.R.

N65-27771# Atomic Energy Commission, Washington, D. C. Div. of Technical Information
RADIOBIOLOGICAL PROBLEMS OF AEROSOLS. PROPERTIES AND HAZARDS OF RADIOACTIVE AEROSOLS PRODUCED BY ATOMIC TECHNIQUE. I: RADIOIODINE (SURVEY) [RADIOBIOLOGISCHE AEROSOLFRAG. EIGENSCHAFTEN UND RISIKEN ATOMTECHNISCHER RADIOAKTIVER AEROSOLE I: RADIOJOB]
W. Herbst 1965 52 p refs Transl. into ENGLISH by Scripta Technica from Zentr. Biol. Aerosol Forsch. (Stuttgart), v. 11, no. 3, 1963 p 232–273
(AEC-TR-6550) CFSTI: $2.00

The properties, distribution, biological hazards, identification methods, and safety measures are reviewed for radioactive iodine, one of the principle radionuclides resulting from atomic fission which is of primary importance in radiation protection. Radioiodine in the biosphere and its environment is considered for air, soil, water, plants, animals, and humans. Biological toxicity of the radionuclide, histological and functional thyroid effects, disturbance of reproductive capability and DNA-metabolism of cells, carcinogenic effects, and genetic effects are included. E.E.B.

N65-27793# Michigan Univ., Ann Arbor. Communication Sciences Lab.
THEORIES OF AURAL PHYSIOLOGY
Dennis H. Klatt Nov. 1964 148 p refs
(Contract Nonr-1224(22))
(Rept.-13; AD-610827)

In this investigation an attempt has been made to formulate specific theories for relating structure to behavior in several portions of the peripheral auditory system. The hypotheses presented are based upon the anatomy and physiology of the mammalian ear. The behavior patterns implied by the set of mathematical assumptions have been investigated by employing homomorphic physical models. An electronic analog of the cochlea and electronic models of primary and secondary auditory neurons have been designed and tested. A general purpose digital computer was used in the design of the cochlear model and in the statistical processing of the outputs of the electronic model neurons. The behavior of the simulated neurons has been compared to that of the natural system as a function of various types of input waveforms. The results of the investigation contribute to a further understanding of the methods of information encoding and processing in the auditory system. Author

N65-27798# Ohio State Univ. Research Foundation, Columbus.
THE POSITIVE AFTERIMAGE AND MEASUREMENTS OF LIGHT AND DARK ADAPTATION, SEPTEMBER 1, 1962–OCTOBER 31, 1964
Glenn A. Fry Brooks AFB, Texas, AF School of Aerospace Med. [1964] 45 p refs
(Contract AF 33(657)-9615)
(AD-610733)

This paper describes an attempt to solve the extent to which adaptation at the center of the fovea undergoes change and to what extent this affects performance of a given task by constructing a system with a sensor which will simulate the changes in position and direction of an eye and provide a running record of changes in retinal illuminance at the center of the fovea. The next step is to build an analog computer which will compute changes in mechanisms of adaptation found in the photoreceptors. A study of the positive afterimage has been carried out with the aim of making allowance for its effect on the state of adaptation. The problems of chromatic adaptation have been considered, but the analog computer described in this report is basically a device for computing changes in bright and dark adaptation. The equations and constants used in designing the computer are based primarily on Rushton's measurements of retinal bleaching and Wright's subjective measurements of bright and dark adaptation. Author

N65-27809# Joint Publications Research Service, Washington, D. C.
PHYSIOLOGICAL EFFECTS OF GRAVITATION
O. G. Gazenko et al 1 Jul. 1965 31 p refs Transl. into ENGLISH of a Russian paper delievered to COSPAR at 8th Plenary Meeting and the 6th Intern. Symp. on Space Sci., Buenos Aires, 10–21 May 1965
(JPRS-30893; TT-65-31392) CFSTI: $2.00

Physiological effects of weightlessness are considered for: 1) the sphere of afference and analyzer activity, 2) the effector sphere and coordination of movements, and 3) the sphere of

regulation of autonomic functions. From various physiological measurements on cosmonauts before and after flight, some preliminary results are indicated. The influence of weightlessness as a mechanical factor does not play a major role directly on the course of physiological processes. Upon entering the weightless state, the following mechanisms of organism adaptations take place: 1) mechanisms of nonspecific adaptation; 2) adjustment in the afferent sphere: new coordination of external and internal analyzers, leading to a possibly clearer picture of the environment than when a subject is under the conditions of gravitation; 3) adjustment in the regulation of activity in the inner organs and new coordination of their activity; and 4) adjustment in somatic functions. L.S.

N65-27837# Air Force Systems Command, Wright-Patterson AFB, Ohio. Biomedical Lab.

THE CARBON DIOXIDE RESPONSE CURVE OF THE DOG AT SEA LEVEL AND AT ALTITUDE

Erwin R. Archibald (Ph.D. Thesis, Calif. Univ.) Dec. 1964 165 p refs

(AMRL-TR-64-145; AD-615967)

Carbon dioxide response curves were measured in three trained dogs before, during, and after an 18-day sojourn at 12,470 ft altitude. The effects of sedation on CO_2 sensitivity were studied in two dogs, using scopolamine and scopolamine-thiopental. In addition, tests were made for the presence of an hypoxic drive component in resting ventilation at altitude by measuring the effect on ventilation of a sudden change in alveolar O_2 tension from 55 mm Hg to 110 mm Hg. Reductions occurred in resting alveolar O_2 and CO_2 tensions to 53 and 71% of sea level control, respectively. On the average, CO_2 sensitivity was increased during the first 10 days to 160% of sea level control. The CO_2 response curve was shifted horizontally to the left by about 8 mm Hg. This decrease in CO_2 threshold was statistically significant ($P < 0.01$). Sedation increased the variability of the results. Tests for an hypoxic drive component showed a transitory reduction in alveolar ventilation occurring 1 minute after the increase in alveolar O_2 tension. In subjects under sedation with scopolamine-thiopental, 40% of resting ventilation was attributable to peripheral chemoreflexes. Author

N65-27857# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ALGAES: CHLORELLA AND FURCELLAIRA, AND THEIR BIOLOGY AND APPLICATION

Henry Bukowiecki and Miroslawa Furmanowa 28 Jan. 1965 12 p Transl. into ENGLISH from Farm. Polska (Warsaw), v. 19, no. 19–20, 1963 p 393–396

(FTD-TT-64-731/1+2; AD-456410)

The relationship between the geological age of algae and their distribution is discussed: the older the algae variety, the wider its habitat. This principle is illustrated in the cases of *Chlorella, Rhodophyta,* and *Phaeophyta.* The strong possibility of using algae as food for astronauts and for purifying air in close quarters is considered. The natural supply and availability of the algae *Furcellaria fastigiata,* of interest as a source of Baltic agar, are outlined. J.M.D.

N65-27877*# Oak Ridge National Lab., Tenn. Neutron Physics Div.

CALCULATED TISSUE CURRENT-TO-DOSE CONVERSION FACTORS FOR NUCLEONS BELOW 400 MeV

C. D. Zerby and W. E. Kinney May 1965 81 p refs Submitted for Publication

(NASA Order R-104; Contract W-7405-ENG-26)

(NASA-CR-63754; ORNL-TM-1038) CFSTI: HC $3.00/MF $0.75 CSCL 06R

To assist in the evaluation of the hazard associated with exposure to high-energy neutrons or protons, a series of Monte Carlo computer programs were used to calculate the energy deposition that results from high-energy incident nucleons as a function of depth in a slab of tissue. The programs included nonelastic and elastic interactions, as well as evaporation processes and nuclear recoils. A 30-cm-thick infinite slab of tissue was treated, and cases of normal and isotropic incidence of 400-, 300-, 200-, 100-, and 60-MeV protons and neutrons were computed. From these data current-to-dose conversion factors were extracted for the average-whole-body, the 5-cm-depth, the surface, and the maximum doses. A set of quality factors (QF's) was adopted for transforming rad dose to rem dose, but detailed energy-deposition data are also presented so that any preferred set of QF's can be used to obtain estimates of the rem dose. dose. Author

N65-27906# RAND Corp., Santa Monica, Calif.

A DEFENSE OF NEURAL MODELLING

Donald H. Perkel and George P. Moore (Calif. Univ., Los Angeles) Jan. 1965 10 p refs

(P-3057; AD-610580)

Several instances are cited of the use of computers by research workers in neurophysiology in gaining information from theoretical neuron models. The general philosophy of theoretical models in research is discussed. This review was motivated by an earlier statement that such use of computers and theoretical models had not been found in the literature on neurophysiology or psychology. J.M.D.

N65-27930# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services

DAMAGE TO METAL-CONTAINING ENZYMES AS A PRIMARY MANIFESTATION OF THE BIOLOGICAL ACTION OF PENETRATING RADIATION

S. Ye. Manoilov Nov. 1964 13 p refs Transl. into ENGLISH from Tr. Mosk. Obshchestva Ispytatelei Prirody (Moscow), v. 7, no. 2, 1963 p 30–41

(T-413-R; AD-610805)

The trigger mechanisms of the primary biological action of penetrating radiation are discussed. Both ionization and molecular excitation are considered in detail. From experimental and theoretical investigations, it is concluded that the primary trigger mechanism of the biological activity of penetrating radiation is connected with the destruction of metal-containing enzymes that catalyze biological oxidation. The result of this damage is to bring about in irradiated tissues an irreversible state of hypoxia leading to the death of highly organized animal organisms. E.E.B.

N65-27933# Stanford Research Inst., Menlo Park, Calif.

EXPERIMENTS ON VISUAL RESPONSES IN INSECTS Final Report, 14 Oct. 1963–14 Oct. 1964

J. C. Bliss, W. D. Chapple, H. D. Crane, and H. F. Seeley Nov. 1964 67 p refs

(Contract AF 49(638)-1112)

(AFOSR-65-0042; AD-610426)

The optomotor response of the milkweed bug *Oncopeltus fasciatus* Dallas (Hemiptera) is described. The bug was placed in the center of a rotating striped drum; as the drum rotates, the bug tends to turn in the direction of rotation. This turning tendency vs drum speed approximates the bell-shaped curve first measured by Hassenstein. Also, the optical constants of compound eyes was measured and offers possible explanation of certain observed phenomena relating to the appearance of multiple image planes behind the array of lenslets. The cyclic discharge of motor fibers in response to decreases in light

intensity is also discussed. A similar discharge was observed using a single 55° rotation about the animal; the ratio of firing frequency of the large motor fibers in the left and right metathoracic roots was a function of the direction of rotation. The firing frequency was also a function of the speed of stripe rotation. Stimulation experiments also suggest that the response is triggered by a simple phasic discharge in the connectives. A physiological model incorporating the results of these experiments is included. E.E.B.

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-26918 Joint Publications Research Service, Washington, D. C.

REACTIONS OF COSMONAUTS DURING PARABOLIC FLIGHT IN AIRCRAFT

I. I. Kas'yan, I. A. Kolosov, V. I. Lebedev, and B. N. Yurov *In its* Effects of Space Flight on Various Physiol. Functions 30 Jun. 1965 p 1-18 refs (See N65-26917 16-04) CFSTI: $2.00

Orientational training flights in aircraft with reproduction of brief episodes of weightlessness are an important element in the system for the preparation of cosmonauts for space flight. The flights permit the detection of individual differences in sensory, motor and vegetative responses of the subjects. During the action of gravitational loads unstable and reversible functional changes in the cardiovascular and respiratory systems of cosmonauts were observed; during the period of weightlessness an approximation of the physiological indices to the level recorded in horizontal flight was seen. The time for normalization of physiological functions under conditions of weightlessness depended primarily on individual peculiarities of the cosmonauts and a difference in their adaptability toward unusual conditions. A distinct resistance of cosmonauts to the intermittent action of gravitational loads and weightlessness has been detected, which can be used for prognostic purposes. Author

N65-26920 Joint Publications Research Service, Washington, D. C.

OCULOMOTOR ACTIVITY IN COSMONAUTS DURING ORBITAL FLIGHTS

I. T. Akulinichev, M. D. Yemel'yanov, and D. G. Maksimov *In its* Effects of Space Flight on Various Physiol. Functions 30 Jun. 1965 p 27-33 refs (See N65-26917 16-04) CFSTI: $2.00

A study of oculomotor activity and the nature of eye movements of four Soviet cosmonauts during three to five days of orbital flight is reported. Results of an analysis of electrooculogram recordings indicated no persistent disturbances in coordination of ocular movements in any of the cosmonauts. Although changes were observed in the aysmmetry of oculomotor reactions and nystagmoid movements in two cosmonauts, the brevity and mildness of these changes were attributed to an actively proceeding process of adaptation to unusual circumstances of the external environment by higher segments of the central nervous system. It is surmised that during flight, the electrooculogram permits a fuller evaluation of the general status of cosmonauts and gives an objective evaluation of the state of the vestibular analyzer. S.C.W.

N65-26948# Electro-Voice, Inc., Buchanan, Mich. Engineering Dept.

[DESIGN OF HELMETS, EARPHONES, AND MICROPHONES] Status Report, Nov. 15-Dec. 15, 1964

Robert C. Ramsey [1964] 13 p ref

(Contract AF 33(615)-1295)

(AD-461367)

The helmet modification to improve its noise attenuation characteristics by sealing the openings at the bottom of the cylindrical portion of the helmet is reported. Also, the possible coupling between the earphone and microphone circuits which can occur in the cabling is considered. Several simulated cable constructions were fabricated and tested using a plastic covered, stranded wire. From the cable measurements and the comparison of these measurements against the loss requirements, it was found that with some limitation of frequency response in the sidetone amplifiers that any of the common cable configurations would be adequate. The use of parallel twisted pairs seems to be the most desirable configuration since the parallel wire construction would be susceptible to external magnetic field pickup and the spiraled construction does not give the degree of protection that the parallel twisted pair gives. E.E.B.

N65-26960# Joint Publications Research Service, Washington, D. C.

PREPARATION FOR HUMAN SPACE FLIGHT

V. Gzhel'skiy and V. Peredel'skiy 28 Jun. 1965 14 p Transl. into ENGLISH from Sovetskiy Voi'n (Moscow), no. 6, Mar. 1965 p 10-12 and 37-40

(JPRS-30817; TT-65-31354) CFSTI: $1.00

A brief nontechnical narrative of the operation of a centrifuge cabin, and of a heat and pressure chamber, during test run with a human subject is given. J.M.D.

N65-26966# Joint Publications Research Service, Washington, D. C.

CYBERNETICS AND PHYSICAL TRAINING

V. M. Zatsiorskiy 23 Jun. 1965 45 p refs Transl. into ENGLISH from Teoriia i Prakt. Fiz. Kul'tury (Moscow), no. 4, Apr. 1965 p 12-20 and no. 5, May 1965 p 22-30

(JPRS-30754; TT-65-31315) CFSTI: $2.00

It is reported that cybernetics can be of great value in studying activities involved in physical training and sports, since both cybernetics and physical training can be considered processes of control. The main object of a physical training program, it is stated, is to achieve the necessary physiological changes with desired magnitude and character rather than to accomplish the given tasks. Therefore, training of athletes should shift its emphasis from control of behavior to direct control of immediate training effect. The relationship between physiological behavior and immediate training effect should be closely investigated, and the development of devices with feedback to monitor activities is suggested. Control of the cumulative training effect is not clearly understood, but it is felt that the methods of cybernetics can be successfully applied here too. Various mathematical models to explain the training process are considered, including simple proportional and factorial linear models and a nonlinear model. Several methods of the algorithmetic diagnosis of training, and theoretical-informational methods in the investigation of the preparedness and actions of athletes are also considered. M.W.R.

N65-26994# Systems Technology, Inc., Inglewood, Calif.

THEORY AND SIMULATION OF PILOTED LONGITUDINAL CONTROL IN CARRIER APPROACH Final Report

Tulvio S. Durand Mar. 1965 86 p refs

(Contract NOw-62-0977-c; NOw-61-0519-c)

(STI-TR-130-1; AD-464703)

Analyses and experiments were performed to determine the causes of the pilot's "inability to control altitude," which is often described as the reason for a (minimum) limiting usable carrier approach airspeed. The analyses indicate that an altitude tracking performance defect is encountered at a certain speed assuming the pilot controls pitch attitude with elevator and altitude with throttle. The speed at which this theoretical "problem" is encountered seems to match well with flight test determined minimum carrier approach speeds for several aircraft. Thus the cause/effect relationship is clearly inferred. However, there is then considerable question as to why alternative piloting techniques which eliminate the "problem" are not used. To investigate such inferences and questions and to lend credence to the analyses, piloted simulation experiments were devised, implemented, and run. The trials and tribulations attending satisfactory fixed-base simulation with a minimum of equipment were encountered early. The steps finally taken to achieve suitable realism are described, as are the detailed results. In general, the results tend to support the theory, and shed some light on possible reasons for pilots' preference for an apparently inferior control technique. Five pilots rated 34 different airframe configurations, each simulating flight characteristics either above or below predicted minimum speeds. These ratings confirm the usefulness of an analytically determined "reversal parameter" for predicting the pilot-selected minimum approach speed. Results are also described of tests on modified airframe and display characteristics aimed at improving system performance. Author

N65-27020# Royal Inst. of Tech., Stockholm (Sweden). Speech Transmission Lab.

SPEECH TRANSMISSION LABORATORY QUARTERLY PROGRESS AND STATUS REPORT, 15 APRIL 1965

Gunnar Fant et al 15 Apr. 1965 61 p refs

(Contract DA-91-591-EUC-3413; Grants AF-EOAR-65-51; NIH G-NB-04003-03)

(STL-QPSR-1/1965)

Speech production and analysis, and aids for the deaf are discussed. The recording and analysis of the vocal tract frequency response by a sweep-tone method for collecting data samples of vowels and consonants was continued. Characteristic curves are shown for various sounds. Voice spectra are analyzed for studying how the source spectrum of a vowel may depend on articulatory factors. Stop gap and transition durations of speech material are analyzed from sound spectrograms; and phonemic identification with lip-reading alone and lip-reading supplemented by residual hearing or tactual communication were compared for effectiveness as training aids for the deaf. L.S.

N65-27029# Joint Publications Research Service, Washington, D. C.

A METHOD FOR SIMULTANEOUS RECORDING OF RESPIRATORY MOVEMENTS AND SPEECH SOUNDS ON THE SAME MAGNETIC TAPE

V. P. Morozov 29 Jun. 1965 6 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 1, no. 6, Jun. 1964 p 762–764

(JPRS-30844; TT-65-31365) CFSTI: $1.00

A method for simultaneously recording speech sounds and excursions of the chest cage during phonation on magnetic tape is presented. Both processes are recorded on the same tape using two monophonic tape recorders. Respiratory movements are recorded electrically from a potentiometer mounted on the subject and activated by a strap which pulls on a cord connected to the potentiometer during respiration. Thus, an electric signal proportional to changes in the perimeter of the subject's chest during speech or singing is recorded synchronously with the sound. This method permits correlation of physical properties of speech sounds with certain phases of respiratory excursions within any time period, multiple simultaneous reproduction of the same recording of the two processes for demonstration purposes, and precise quantitative measurement of the magnitude of respiratory excursions according to the magnitude of output voltage of the recorder or amplitude of the graphic re-recording. R.N.A.

N65-27032# Joint Publications Research Service, Washington, D. C.

MAN'S CAPACITY TO WORK IN A STATE OF WEIGHTLESSNESS

A. V. Yeremin, I. I. Kos'yan, I. A. Kolosov, V. I. Kopanev, and V. I. Lebedev 29 Jun. 1965 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (Moscow), no. 3, May–Jun. 1965 p 329–334

(JPRS-30849; TT-65-31370) CFSTI: $1.00

In discussing reactions to weightlessness, the observation is made that spacemen have been able to do their jobs because they have been given relatively simple, short, methodical tasks to perform. In addition, the spacemen usually have been anchored to their work places. More complicated tasks which will require mobility will be necessary for prolonged space voyages. To overcome the unfavorable effects of weightlessness, it is suggested that research follow two paths: the first is to increase the potential of the human being and his ability to adapt to changes in gravitation; the second is to continue to improve space vehicles and their equipment. M.W.R.

N65-27091# Aerospace Medical Div. Aerospace Medical Research Labs. /6570th/, Wright-Patterson AFB, Ohio. Behavioral Sciences Lab.

EFFECT OF AUGMENTED TELEVISION DEPTH CUES ON THE TERMINAL PHASE OF REMOTE DRIVING Final Report, Jan.–Apr. 1964

William N. Kama Apr. 1965 13 p ref

(AMRL-TR-65-6; AD-615929)

The ability of eight untrained subjects to position a mobile remote handling unit in the fore and aft dimension was assessed under each of four different viewing conditions. The viewing conditions investigated were: (a) direct viewing, (b) conventional 2-dimensional (2-D) closed-circuit television, (c) 2-D closed-circuit television augmented by shadows at the target, and (d) 2-D closed-circuit television augmented by converging light beams moving with the mobile unit. The results indicate that the augmented television conditions (c and d) facilitated successful positioning of the mobile unit. Under the augmented television conditions (c and d) there was a tendency to overshoot the target slightly. However, the amount and variability of the positioning errors were less under the augmented television conditions than under either the direct viewing condition or the conventional, unaugmented, television condition. The converging light system merits further investigation as a method of providing range information. Author

N65-27092# Lockheed-Georgia Co., Marietta.

PERFORMANCE OF VIGILANCE AND MONITORING TASKS AS A FUNCTION OF WORKLOAD Final Report, Dec. 1962–Apr. 1964

Thomas J. Hall, George E. Passey, and Thomas W. Meighan Wright-Patterson AFB, Ohio, AMRL Mar. 1965 27 p

(Contract AF 33(657)-10506)

(AMRL-TR-65-22; AD-615921)

This study was conducted to obtain control data on the performance of three passive tasks—auditory vigilance, warning lights monitoring, and probability monitoring—performed previously in conjunction with three active tasks. Subjects were tested for 4 hours on each of 6 successive days. A task schedule

requiring performance of all six tasks was employed on 2 hours of each daily session, while performance on the passive tasks alone was carried out during the remaining 2 hours. Performance on auditory vigilance, green warning lights, and probability monitoring was found to be superior when these passive tasks were performed alone. No difference in performance was found for red warning lights. Author

N65-27158# Space Technology Labs., Inc., Redondo Beach, Calif. Environmental Control Equipment Section.
FIRST GENERATION MANNED SPACECRAFT ENVIRONMENTAL CONTROL SYSTEM
H. L. Mandelstam and A. W. Optican Mar. 1963 54 p refs
(STL-9990-6397-RU-000)

The requirements, operation, and subsystems of a typical first generation environmental control system for a manned spacecraft are described. The subsystems include the space suit, air circulation, solid contaminant, carbon dioxide removal, trace gas contaminant control, primary and secondary oxygen supply, snorkel and cabin exhaust, coolant tank pressurization, and thermal control. Appendixes include calculations for the carbon dioxide removal and trace gas contaminant subsystems, and suit circuit and cabin heat exchangers. R.N.A.

N65-27188# Ohio State Univ., Columbus. Lab. of Aviation Psychology.
THE INFLUENCE OF EXPERIENCE AND INPUT INFORMATION FIDELITY UPON POSTERIOR PROBABILITY ESTIMATION IN A SIMULATED THREAT-DIAGNOSIS SYSTEM Technical Report, 1 Oct. 1963–1 Jun. 1964
David A. Schum, Irwin L. Goldstein, and Jack F. Southard Wright-Patterson AFB, Ohio, AMRL, Apr. 1965 78 p refs
(Contract AF 33(657)-10763)
(AMRL-TR-65-25; AD-615758)

This report describes two experiments in which posterior probability estimates made by humans are compared with similar estimates made by a computer using a modification of Bayes' theorem incorporating human estimates of P(D|H). The task was to estimate, on the basis of intelligence data from a simulated threat-evaluation situation, the likelihood of various alternative hypotheses that could account for the observed data. The purpose of the first experiment was to determine the effect of increased experience upon the human's ability to estimate posterior probabilities. The purpose of the second experiment was to compare human and automated posterior probability estimates under several levels of input data fidelity. With respect to the design of diagnostic systems, the present research tends to confirm the feasibility of automated Bayesian hypothesis-selection incorporating expert human estimates of the conditional probabilities P(D|H). Author

N65-27205# Office of Naval Research, Washington, D. C. Engineering Psychology Branch.
HUMAN ENGINEERING PROBLEMS OF LOW-ALTITUDE, HIGH-SPEED FLIGHT
James W. Mille [1964] 8 p refs Presented at AGARD Specialists Meeting on Low-Altitude, High-Speed Flight, Paris, 20–23 Oct. 1964
(AD-460918)

Pilot task loading, function allocation, specific displays, and pilot selection are discussed in reference to the human engineering aspects of low altitude flight. In a man-machine system, man is capable of functioning as a servomechanism, a controller, and a computer. However, this "black box" concept of him must take into account his physiological limitations, individual differences, motivation, nonlinearity, and adaptation. Pilot task loading is increasing and the margin of tolerable error is becoming narrower. In a low level flight a pilot must now perform more functions in less time than previously afforded him. In a low level system instrumentation design, the tendency has been to use conventional high altitude displays. High accuracy altimeter and turn and pitch displays require special consideration for low level missions. Proper maps must be designed using scale factors appropriate for the altitude. The matching of particular men to particular machines must be considered in pilot selection. Pilots differ greatly in their reactions to stress, buffeting, ability to get lost, and in their confidence of automatic systems. R.N.A.

N65-27217 Defence Research Medical Labs., Toronto (Ontario).
THE PHASE DIFFERENCE FUNCTION IN BINOCULAR FLICKER
P. J. Foley and P. Stager Repr. from Can. Psychology, v. 19, no. 1, 1965 p 47–55 *Its* Res. Paper No. 545

Two experiments were carried out to determine the functional relation between the critical flicker frequency (CFF) of two identical intermittent targets, binocularly superimposed, and the phase difference between the targets. Binocular CFF is a monotonic decreasing function of phase difference, positively accelerated for phase differences between 0° and 180°, and negatively accelerated for phase differences between 360° and 180°. It is postulated that the results can be accounted for by assuming the existence of something akin to the "isodynamic" cells of Cajal, and that more weight is attached to the input to these cells from one eye than from the other. Author

N65-27287# Air Force Systems Command, Wright-Patterson AFB, Ohio. Behavioral Sciences Lab.
ENGINEERING PSYCHOLOGY, TRAINING PSYCHOLOGY, ENVIRONMENTAL STRESS, SIMULATION TECHNIQUES, AND PHYSICAL ANTHROPOLOGY. 1964 SUPPLEMENT TO BIBLIOGRAPHY OF REPORTS ISSUED BY BEHAVIORAL SCIENCES LABORATORY
Lavon E. Trygg, comp. 1 Jan. 1965 16 p refs
(AD-464531)

N65-27334# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Biophysics Lab.
A SUMMARY OF HUMAN TOLERANCE TO PROLONGED ACCELERATION Final Report, Jan. 1963–Jan. 1965
Alvin S. Hyde and Harold W. Raab Feb. 1965 42 p refs
(AMRL-TR-65-36; AD-615329)

Human subject tolerance to accelerations of greater than one second duration is summarized for the orthogonal X, Y, and Z axes. Because each investigator at each laboratory utilizes different restraint systems, body positions, ambient temperatures, etc, and most important, utilizes different criteria of "tolerance," the data are referenced and presented in tables and graphs for each major category (direction) of acceleration. The points presented in the graphs and tables are usually the highest values achieved; in each series there were subjects who could not tolerate the given direction, amplitude, and duration.

N65-27388*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
LEKTON
Warren S. Mc Culloch [1965] 66 p Introduction to "Logical Structure of Mind" by Eilhard von Domarus
(Grants NsG-496; NSF GP-2495; NIH G-MH-04737-04; Contracts DA36-039-AMC-03200(E); AF 33(615)-1747 et al)
(NASA-CR-63609) CSCL 06J

A discussion of the philosophical foundation of psychology and psychiatry is presented, and the ontological significance of facts (called entities or relata) is demonstrated with respect to their responsibility for the logical structure of mind. The discussion is divided into three categories: (1) the sciences of

mind, (2) the science of matter, and (3) the science of the concrete. Certain terms such as "passage", "extension", "idea", and "intention", are defined and related throughout to the discussion. Under the first category, topics such as associationlism, gestalt, reflexology, social and act psychology, and dynamism are discussed. In the second category, the entities are discussed from the viewpoint of Newtonian mechanics, statistical mechanics, biology, biophysics, and relativity. Relations, concreteness, evolution, ambiguity, idea origin, intention, mattering, minding, logical mind structure, and extraduction are other aspects of the general theme that are deliberated. L.S.

N65-27397*# Bunker-Ramo Corp., Canoga Park, Calif.
MEASUREMENT CRITERIA IN MAN MACHINE SYSTEMS SIMULATION
R. W. Obermayer Washington, NASA, Jul. 1965 24 p refs (Contract NASw-869)
(NASA-CR-257) CFSTI: HC $1.00/MF $0.50 CSCL 05H

This report describes simulation, models and games as analogies. They resemble in some way something else about which information is desired. We may therefore measure an analogy instead of the real-world object. Critical dimensions of analogies are the level of abstraction and the fidelity of simulation, however, if the object is to measure, the most critical aspect is the validity of measurement. Unfortunately, validity is not always a practical concept. Since the objective of measurement is to derive information, simulation studies are analyzed with respect to information objectives in the attempt to derive criteria for measure selection. Author

N65-27420# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
TORQUE FREE ROTATIONAL DYNAMICS OF A VARIABLE-CONFIGURATION BODY (APPLICATION TO WEIGHTLESS MAN)
James M. Mc Crank and Daniel R. Seger (M.S. Thesis) May 1964 170 p refs
(GAW/ME/64-19; AD-610239)

The foreseen problems of a free-floating space worker require a theoretical method of analyzing the rotational effects of body configuration changes. To complete such a study, a mathematical model of the human body was utilized to approximate the dynamic properties of the body. Assuming the body to be isolated (no external torques or forces), the principle of conservation of angular momentum (about the system center-of-mass) was applied to develop three simultaneous, first order, non-linear differential equations with variable coefficients. The components of the body spin vector are the time dependent quantities in these equations. A computer program was developed to solve the equations by numerical methods. Results of the program include: body spin vector components and their rates of change, position of the system center-of-mass, acceleration of various points in the system, and body orientation change. Author

N65-27710*# National Aeronautics and Space Administration, Washington, D. C.
PHYSIOLOGICAL AND HYGIENIC EVALUATION OF THE LIFE SUPPORT SYSTEMS USED ON VOSTOK AND VOSKHOD SPACECRAFT [FIZIOLOGOGIGIENICHESKAYA OTSENKA SISTEM ZHIZNENNOGO OBESPECHENIYA KOSMICHESKIKH KORABLEY "VOSTOK I VOSKHOD"]
G. I. Voronin, A. M. Genin, and A. G. Fomin Jun. 1965 17 p Transl. into ENGLISH from paper presented at the Second Intern. Symp. on Basic Environ. Probl. of Man in Space, Paris, 14–18 Jun. 1965
(NASA-TT-F-9424) CFSTI: HC $1.00/MF $0.50 CSCL 06K

The life support systems for the Vostok and Voskhod spacecraft were developed within the design limitations of the craft to cover normal flight and some emergency situations. Extensive ground research went into the design of these systems, which are not self-regenerating but are based on chemically-bound oxygen, CO_2 and water vapor absorbents, and carried food and water stocks. Various life support schemes and their suitability under different flight conditions are discussed. Data from ground studies of life support systems are presented and compared with data from actual flights. Author

N65-27714*# National Aeronautics and Space Administration, Washington, D. C.
HUMAN RELIABILITY IN SPACECRAFT CONTROL SYSTEMS [PROBLEMY NADEZHNOSTI CHELOVEKA V SISTEMAKH UPRAVLENIYA KOSMICHESKIM KORABLEM]
P. K. Isakov, V. A. Popov, and M. M. Sil'vestrov Jun. 1965 11 p refs Transl. into ENGLISH of Paper presented at 2d Intern. Symp. on Basic Environ. Probl. of Man in Space, Paris, 14–18 Jun. 1965 11 p
(NASA-TT-F-9428) CFSTI: HC $1.00/MF $0.50 CSCL 05H

The special problem of man's reliability as operator in different spacecraft control systems necessitates models permitting estimating stability of optimum and prescribed working characteristics and their physiological mechanism. Weightlessness, alternating time allowances to function, and multiple information transfer determine peculiarities in constructing systems. Author

N65-27730# Advisory Group for Aeronautical Research and Development, Paris (France).
CURRENT RESEARCH ON ADVANCED COCKPIT DISPLAY SYSTEMS
Roger L. Winblade (NASA, Flight Res. Center) Oct. 1964 27 p refs
(AGARD-491)

Current cockpit display philosophy is discussed in terms of the pilot's informational requirements. Pilot's scan patterns obtained through the use of an eye-position camera and a ground-based simulator are depicted for both a conventional display system and two advanced concepts. Preliminary results of some flight-test and ground-simulation evaluations of advanced concepts, such as totally integrated displays and indirect pilot viewing systems, are discussed. Author

N65-27862# Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
FLASHBLINDNESS PROTECTION: THE EYE PATCH
J. H. Hill and Gloria T. Chisum 5 May 1965 28 p refs
(NADC-ML-6326; AD-464192)

Two experiments were conducted to evaluate the effectiveness of a simple eyepatch as a flashblindness protective device and to provide an indication of the desirability of using large numbers of observers in flashblindness research. The results indicate that a simple eyepatch does provide some protection from flashblindness and that a completely light tight seal is not necessary for this device to be effective. Because of the noxious nature of the stimulus, the general applicability and significance of data collected from large numbers of observers is questionable. The results of unsophisticated and, presumably, relatively unmotivated observers are at variance with those of more sophisticated observers. Author

N65-27891# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
HUMAN FACTORS IN REMOTE HANDLING: A REVIEW OF PAST AND CURRENT RESEARCH AT THE AEROSPACE MEDICAL RESEARCH LABORATORIES

William N. Kama Jul. 1964 13 p refs
(AMRL-TR-64-122; AD-610732)

This report discusses and summarizes the human factors research that has been accomplished in the area of remote handling since 1959. Discussion of this research program is made in terms of the various factors that affect remote handling operations—task variables, equipment variables, operator variables, sensory/perceptual problems, and controls. Identification of future research areas is made. Author

N65-27946*# Systems Technology, Inc., Hawthorne, Calif.
DEVELOPMENT OF SATISFACTORY LATERAL-DIRECTIONAL HANDLING QUALITIES IN THE LANDING APPROACH
Robert L. Stapleford, Donald E. Johnston, Gary L. Teper, and David H. Weir Washington, NASA, Jul. 1965 122 p refs (Contract NAS2-864)
(NASA-CR-239) CFSTI: HC $4.00/MF $1.00 CSCL 01B

An analytical method is presented for developing satisfactory lateral-directional handling qualities in the landing approach. The method includes the following three steps: 1. Analysis of the handling qualities of the basic airframe to determine what deficiencies, if any, exist; 2. Determination of stability augmentation requirements for satisfactory handling qualities; and 3. Assessment of the operational tradeoffs among the various mechanizational possibilities. Preliminary estimates of the values necessary for a good pilot rating are derived from previous studies and from tests of several supersonic transport configurations evaluated on the Transport Landing Simulator. Author

N65-27953*# Washington Univ., St. Louis, Mo. Dept. of Economics
THE SUPPLY OF ENGINEERS AND SCIENTISTS
Hugh Folk 10 Jun. 1965 61 p refs *Its* Working Paper No. 6506
(Grant NsG-342)
(NASA-CR-27953) CFSTI: HC $3.00/MF $0.75 CSCL 05I

Some of the aspects of the supply of engineers and scientists are discussed and data are presented on enrollments, degrees, earnings, and occupational choices of persons with engineering and science degrees. Among the conclusions of the analysis were the following: (1) Over the period 1950 to 1960, the rate of change of the number of nongraduate engineers in the various specialties is highly correlated with the rate of change of the number of graduate engineers in the same specialties. (2) Men graduating in engineering and science do not all enter engineering or science. The proportion of engineering graduates entering such jobs is much higher than the proportion of men with science degrees. (3) Over one-half of the very able freshmen choosing engineering and science as careers change career anticipations by their senior year. (4) Over the past 30 years there has been little change in the prestige ranking of engineering relative to other occupations commonly entered by college graduates. Engineering starting salaries have increased steadily as a percentage of general business trainees starting salaries, however, for chemists such salaries have declined. E.E.B.

N65-27956*# Arlington State Coll., Tex.
[A STUDY OF THE EFFECTS OF PROTECTIVE FILTERS AND LENSES ON COLOR JUDGEMENT] Final Report
Garvin Mc Cain [1957] 14 p refs
(Grant NsG-548)
(NASA-CR-63766) CFSTI: HC $1.00/MF $0.50 CSCL 05E

Continued studies on human color vision, which were designed to determine the effects of protective filters and lenses on color judgment, are reported. Presented are preliminary results of an extended study which focuses on determining whether previously observed shifts in color judgments following prolonged exposure to color lenses was an increasing function of the period of exposure. Results suggest that prolonged exposure to a part of the spectrum may change color judgments and that this change may persist over extended periods. Inherent problems associated with test apparatus and equipment are discussed. Although there is no clear theoretical explanation of the shift in color judgments, the effect resembles after effects found in other sense modalities. Speculation is made concerning the influence of some process above the retinal level on color judgment shifts. S.C.W.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-26767 Naval Ordnance Lab., Corona, Calif. Chemistry Div.
SYNTHESIS OF A CYCLIC HEXAPHENYLDICHLOROPHOSPHONITRILE TETRAMER AND ITS REACTION WITH DIOLS
D. L. Herring and C. M. Douglas *In its* Foundational Res. Proj. 1 Mar. 1965 p 5–15 refs (See N65-26765 16-26)

The linking of cyclic phosphonitriles of controlled functionality with thermally stable coupling agents was investigated in an effort to prepare polymeric materials for high temperature application. A third nongeminal hexaphenyldichlorophosphonitrile was prepared by employing a mixture of halophosphines in the synthesis of difunctional phosphonitriles. The coupling of this compound with mono- and difunctional alcohols is described, and polymers were prepared from the reaction of the hexaphenyldichlorophosphonitrile tetramer with aromatic diols, and by its condensation with the corresponding diethoxy- and dihydroxyhexaphenyl-phosphonitrile tetramers. G.G.

N65-26768 Naval Ordnance Lab., Corona, Calif. Chemistry Div.
COUPLING REACTIONS BETWEEN HEXAPHENYLDIAZIDOCYCLOPHOSPHONITRILE AND SELECTED BIS-TERTIARY PHOSPHINES
A. J. Bilbo and C. M. Sharts *In its* Foundational Res. Proj. 1 Mar. 1965 p 16–43 refs (See N65-26765 16-26)

Conversion of the dichloro compound of hexaphenyldichlorocyclophosphonitrile to the diazido compound was accomplished in 65% yield by reaction of the former with lithium azide in refluxing acetonitrile. The tetramer diazide, hexaphenyldiazidocyclophosphonitrile, was thoroughly characterized by its infrared spectrum, molecular weight, and elemental analysis. From the reaction mixture a second compound was isolated, believed to be an isomer of the tetramer diazide. Two bisphosphines linked by a perfluorinate group were prepared, and some polymer prototypes were formed by coupling of phenyl azide with bis-phosphine, and by coupling of the tetramer diazide with simple tertiary phosphines. Coupling of a tetramer diazide with bis(diphenylphosphino)butane in refluxing chlorobenzene gave a white powdery material which melted in the range 245° to 250° C. G.G.

N65-26792 Aerojet-General Corp., Sacramento, Calif.
CHEMORHEOLOGICAL STUDIES OF CARBOXY-TERMINATED POLYBUTADIENE TYPE BINDER

P. C. Colodny, L. A. Waddle, and J. S. Wood In APL Bull. of the 3d Meeting Interagency Chem. Rocket Propulsion Group Apr. 1965 p 65–84 refs (See N65-26788 16-27)

The cleavage and crosslinking reactions occurring within propellant binders prepared from carboxy-terminated polybutadiene were studied by means of high temperature stress relaxation. The site of cleavage for a series of binders prepared using various crosslinkers was determined. The effect of different antioxidants, antioxidant concentrations, combinations of antioxidants and various additives was studied. Measurements were also performed under high vacuum and steam pressures in order to isolate oxidative, thermal and hydrolytic reactions. Author

N65-26927# Canterbury Univ., Christchurch (New Zealand).
GAS PHASE REACTIONS
L. F. Phillips Mar. 1965 5 p refs
(Grant AF-AFOSR-264-63)
(AFOSR-65-0676; AD-615176)

Emission intensity of metallic lines from the reaction flames of thallous halides and other metal halides were found proportional to the square of the nitrogen atom concentration, and to the first power of the metal halide concentration, in the gas phase. The intense blue and ultraviolet emission reaction flame of iodine and active nitrogen was characterized as the transfer of electronic energy to an I_2 molecule from a metastable species which is produced during the reaction. Reactions of active nitrogen with chlorine and bromine did not produce metastable species. Photometric measurements of O, H, and OH in a series of O_2-rich $H_2/N_2/O_2$ burner flames indicated a change-over from $H + OH + M \rightarrow H_2O + M$ to $O + O + M \rightarrow O_2 + M$ as the predominant radical recombination process. The relative rates of the different primary reaction processes of nitrogen atoms with NO_2 were measured by mass spectrometer and photometric techniques. G.G.

N65-26969# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
REACTION OF HYDROGEN WITH NIOBIUM AND TANTALUM IN THE ATR GAS LOOP
L. A. Charlot Apr. 1965 16 p refs
(Contract AT(45-1)-1830)
(BNWL-48) CFSTI: $1.00

This report reviews recent literature concerned with the hydrogen–niobium and the hydrogen–tantalum systems. Hydrogen embrittlement of refractory metal is a potential problem in the operation of the ATR gas loop. The extent of hydrogen pick-up and the relative rates of sorption–desorption must be considered for the ATR loop operation. The data reviewed indicates that, due to the low contaminant concentrations expected in the helium gas stream, hydrogen should not be significant in influencing the mechanical properties of niobium or tantalum in the ATR loop. Hydrogen concentrations can be predicted on the basis of hydrogen partial pressures, temperature, and total pressure. The effects of specific hydrogen levels on mechanical properties and subsequent behavior are not so easily predicted. It can be said qualitatively that hydrogen levels of 500 ppm will embrittle niobium. Hydrogen levels of 200 ppm will raise the porportional stress limit of niobium. Final analysis of hydrogen levels detrimental to the refractory metals must be made from observation in the ATR gas loop itself. N.E.A.

N65-26987# General Dynamics/Convair, San Diego, Calif. Space Science Lab.
INTEGRATED INTENSITY MEASUREMENTS ON THE FUNDAMENTAL AND FIRST OVERTONE BAND SYSTEMS OF CO BETWEEN 2500° AND 5000°K
J. C. Breeze and C. C. Ferriso May 1965 24 p refs
(Contract Nonr-3902(00); Proj. Defender)
(GD/C-DBE-65-007; AD-464921)

Measurements have been made of the total absolute integrated intensities of the 4.7-μ fundamental and 2.4-μ first overtone band systems of CO at various temperatures within the range 2500° to 5000° K. The CO gas sample was studied in emission using a reflected shock wave to raise the sample to the high temperatures. Effects of vibrational relaxation, dissociation and shock structure have been considered in the data interpretation. Within the temperature range used in the present experiments, the integrated intensity of the CO fundamental band system remains constant. However, the integrated intensity of the CO first overtone band system shows a small increase with increasing temperature. The temperature dependencies of the two band systems are in agreement with the theoretical temperature dependencies. The present experimental results for CO extrapolated to STP are $289 \pm 29\ cm^{-2} \cdot atm^{-1}$ and $2.3 \pm 0.3\ cm^{-2} \cdot atm^{-1}$ for the total integrated band intensities of the fundamental and first overtone band systems respectively. Author

N65-26991# Esso Research and Engineering Co., Baytown, Tex.
REACTIONS OF GASEOUS IONS XVI. EFFECTS OF ADDITIVES ON IONIC REACTIONS IN METHANE
M. S. B. Munson and F. H. Field May 1965 25 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(HUM-12-P; AD-465148)

Studies are reported on the ionic processes occurring in the source of a mass spectrometer at pressures up to 2 Torr for mixtures of CH_4 + 1%X, where X = Kr, Xe, O_2 NO, H_2O, and ND_3. The proton affinities of Kr and Xe are less than 118 kcal/mole since proton transfer from CH_5^+ does not occur. Kr, Xe, O_2, and NO have very little effect on the distribution of product ions in methane and the proton affinities of both O_2 and NO are less than that of CH_4. Water and ammonia produce major changes in the ionic distribution at 2 Torr, since about 90% of the total ionization is composed of hydrated or ammoniated protons. Proton transfer from CH_5^+ and $C_2H_5^+$ to water and ND_3 is rapid. Rapid hydrogen-deuterium exchange is observed between ND_3-H^+ and ND_3, but exchange is not observed between ND_4^+ and CH_4. Author

N65-27018# Mound Lab., Miamisburg, Ohio.
STATUS OF STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION AT MOUND LABORATORY—1963
W. J. Haubach, C. F. Eck, W. M. Rutherford, and W. L. Taylor 18 Jun. 1965 84 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1239) CFSTI: $3.00

Progress is reported on a program which is concerned with isotope separation and purification. Areas of research covered during the report period include: (1) carbon isotope separation; (2) helium-3 separation, purification, and research; (3) neon isotope separation; (4) argon isotope separation; (5) krypton isotope separation; (6) xenon isotope separation and purification; and (7) thermal diffusion research. N.E.A.

N65-27082# RAND Corp., Santa Monica, Calif.
ON THE THERMODYNAMICS OF CALCITE
F. J. Krieger May 1965 35 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4590-PR; AD-615657)

The purpose of this study is the thermodynamic investigation of calcite, $CaCO_3$, over a range of temperatures up to 6000° K and pressures up to 10^5 atmospheres. Two sets of equilibrium composition equations are used–one representing a

pure gas phase, the other a heterogeneous system of gas and condensed (i.e., solid or liquid) calcia, CaO. The gas phase of the heterogeneous chemical system, like the homogeneous gas phase, comprises 13 gaseous calcium-carbon-oxygen species. The results of the computational program are presented in both tabular and graphic form. The latter is a conventional Mollier diagram in which specific enthalpy is plotted against specific entropy, with cross plots of temperature, pressure, and molecular weight. Author

N65-27093# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
EXPERIMENTAL STUDY OF ZONE REFINING OF THE BINARY SYSTEM TRIPHENYL ANTIMONY-BIPHENYL
Marvin S. Brooks and Willard R. Hancock Apr. 1965 106 p refs *Its* Environmental Research Papers No. 95
(AFCRL-65-231; AD-615968)

The results of an experimental study of zone refining of the binary system triphenyl antimony–biphenyl are presented. The isotope Sb^{124}, which is a strong gamma emitter, was employed as a tracer; this allowed a rapid in situ nondestructive analysis, closely spaced experimental points, and the opportunity to study distribution as a function of varying experimental conditions. With the aid of computers (IBM 7090 and IBM 7044) apparent k's were calculated and the experimental data compared with those predicted from various mathematical models. Author

N65-27094 Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
THE EVOLUTION OF AN IONOSPHERIC HOLE
Malcolm A. Macleod and Dan Golomb Apr. 1965 28 p refs *Its* Environmental Research Papers No. 101
(AFCRL-65-287; AD-615969)

The release of 10^{26} molecules of sulfur hexafluoride at 220-km altitude generated an ionospheric hole which lasted about 30 minutes. Rate equations are set up and solved to explore the time and space variation of electron densities within the region. It is shown that due to the geomagnetic-field-constrained diffusion of electrons, the estimated lifetime of the hole is much longer than if unhindered radial diffusion could take place, and that the estimated lifetime is commensurate with the observed lifetime. A more quantitative comparison between the theoretical model and the observational data is possible only if the rate constants and the radio frequency sounder characteristics are specified more closely than is currently possible. Author

N65-27167# Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.
IDENTIFICATION AND DETERMINATION OF REACTIVE EPOXY DILUENTS BY GAS-LIQUID CHROMATOGRAPHY Final Report
George G. Esposito 24 May 1965 7 p
(CCL-180; AD-615952) CFSTI: $0.50

Programmed temperature gas chromatography (PTGC) is employed for the identification and determination of epoxy type reactive diluents in solventless epoxy compounds. The analysis can be applied directly to the product to be tested or, in the case of butyl glycidyl ether, to a sample separated from the resin. Author

N65-27210# Auburn Univ., Ala.
A STUDY OF THE DECOMPOSITION MECHANISMS OF AMMONIUM PERCHLORATE Quarterly Progress Report, 22 Feb.–1 Jul. 1964
James E. Land 1 Jul. 1964 16 p refs
(Contract DA-01-009-ORD-1023)
(AD-457938)

A survey of background information on the decomposition of ammonium perchlorate (AP), and on the decomposition of alkali metal chlorates, perchlorates, nitrates, nitrites, and chromates is presented. The differential thermal analysis technique and pertinent equations, decomposition mechanisms, crystal transformation, thermal explosion of AP, and catalyst influence on AP decomposition are discussed. The review is preliminary to studying the kinetics of the decomposition of AP. By studying the reaction order and the activation energies, a better understanding of the rate controlling step should lead to better selection of catalysts needed to achieve maximum realization of the oxidizing potential of the decomposition reaction. L.S.

N65-27288# Stauffer Chemical Co., Richmond, Calif. Western Research Center
HIGH ENERGY OXIDIZERS Quarterly Technical Summary Report, 1 Feb.–30 Apr. 1965
Karl O. Christe, Jacques P. Guertin, A. E. Pavlath, and E. G. Wallace [1965] 18 p refs Submitted for Publication
(Contract Nonr-4019(00); ARPA Order 399-62)
(AD-432061)

The difluorochlorates (I) of cesium, rubidium, and potassium were successfully prepared by the reaction of the corresponding fluorides with chlorine monofluoride or $NO^+ClF_2^-$. These white crystalline solids are the first known difluorochlorate (I) salts stable at 25°. They decompose exothermically at temperatures higher than 230°. Their composition and structure were established by elemental analysis, infrared, and X-ray studies. The salts are ionic, contain linear ClF_2^- anions, and crystallize tetragonally in the α-KHF_2 lattice type. The unit cell dimensions of $CsClF_2$, $RbClF_2$, and $KClF_2$ are: a = 6.10 Å., c = 7.78 Å., a = 5.88 Å., c = 7.23 Å., a = 5.63 Å., c = 6.72 Å., respectively. Attempts to prepare $LiClF_2$ and $Ca(ClF_2)_2$ failed, while $NaClF_2$, $Ba(ClF_2)_2$, and $Sr(ClF_2)_2$ may have formed to a very small extent. Author

N65-27332# Princeton Univ., N. J. Frick Chemical Lab.
POLYMIDES
Stuart Cooper, D. Mair, and A. V. Tobolsky May 1965 21 p refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-86; AD-463880)

The mechanical properties of four different polyimide samples were compared. H-film, poly(N,N'-(p,p'-oxydiphenelene) pyromellitimide), shows no softening phenomena below 500° C. The three other polyimides studied show a definite softening at elevated temperatures. All of the samples investigated show evidence of chemical reaction and eventual degradation taking place above 400° C. X-ray photographs show H-film to be slightly crystalline. The other members of the polyimide group investigated reveal a typical amorphous scattering pattern. Factors such as the purity of starting materials and the problem of complete conversion to polyimide linkage must be considered when comparing the mechanical properties of these various polyimides. Author

N65-27343# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
THE DETERMINATION OF CHLORINE IN POLYPHENYL REACTOR COOLANTS AND RELATED ORGANIC COMPOUNDS
R. B. Stewart, R. W. Jones, S. Elchuk, and G. G. Smith Jan. 1965 28 p refs
(AECL-2137) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

A rapid method for the analysis for chlorine the polyphenyls, and organic solutions is described. It consists of a decomposition of the organic matrix by combustion in an oxy-hydrogen flame, condensation of the water vapour and hydrochloric acid produced and determination of the chloride by precision null-point automatic titrimetry. A sensitivity of 0.5 ppm chlorine is available in low- and medium-viscosity samples, 1 ppm in high-viscosity coolants. Author

N65-27347*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OBSERVATIONS ON AFFINITY AND KINETIC BEHAVIOR OF SOME CHEMICAL REACTIONS
Marvin Garfinkle Washington, NASA, Jul. 1965 22 p refs
(NASA-TN-D-2875) CFSTI: HC $1.00/MF $0.50 CSCL 07D

A number of homogeneous stoichiometric chemical reactions were investigated to determine the particular manner in which the affinity varied with time as these reactions proceeded. The actual kinetic data were solicited from investigators whose results had appeared in the literature. The study included both gas-phase and liquid-phase reactions. For more than two-thirds of the 113 reactions investigated, a single empirical relation was sufficient to describe the manner in which the affinity varied with time. The correlation of the observed reactions by this relation was at least equal to that attainable by use of the classical empirical rate equations. Author

N65-27359# Rocket Propulsion Establishment, Westcott (England).
PERCHLORIC ACID: ITS STABILITY AND ITS REACTION WITH HYDROGEN AND SIMPLE ORGANIC COMPOUNDS. PART I: THE HARMLESS NATURE OF CONSTANT BOILING 72% PERCHLORIC ACID. PART 2: THE OXIDATION OF SOME ORGANIC SUBSTANCES BY PERCHLORIC ACID
W. Dietz and A. Vialard-Goudou Jan. 1964 11 p refs Transl. into ENGLISH from Angew. Chem. (E. Germany), no. 52, 1939 p 616–618 and Compt. Rend., no. 203, 1936 p 565–568
(RPE-TRANS-8)

Boiling 72% perchloric acid is not exploded by heat, an electric arc or by detonation of lead azide. 72% perchloric acid vapor is decomposed at 400 to 405° C with the appearance of a flame. A mixture of the vapor with hydrogen explodes at 400 to 405° C; in the presence of steel turnings the ignition temperature is reduced to 215° C. In the Part II study, 65% perchloric acid was heated in sealed tubes with simple organic compounds, carbon and hydrogen. It is concluded that oxidation is by perchloric acid and not by the decomposition products of perchloric acid, chlorine, oxygen and water. Author

N65-27384*# Battelle Memorial Inst., Columbus, Ohio.
ENGINEERING PROPERTIES OF POTASSIUM Tenth Quarterly Report, Jan. 1–Mar. 31, 1963
Alexis W. Lemmon, Jr. 30 Apr. 1963 17 p refs
(Contract NAS5-584)
(NASA-CR-63581) CFSTI: HC $1.00/MF $0.50 CSCL 07D

Measurements of the viscosity, vapor pressure, and heat content of liquid potassium have been concluded. Values for the heat of vaporization, derived from the vapor pressure data, range from 910 Btu/lb at 1300 R to 609 Btu/lb at 2600 R. Thermal conductivity and electrical resistivity have been measured up to about 800° C. Modifications in the apparatus and the amount of K in the specimen container have been made to permit measurements up to 1150° C. Nondestructive testing of the container is underway. Observed thermal conductivities of the Nb–1Zr container material are from 0.47 watt $cm^{-1}C^{-1}$ at 100° C to 0.66 watt $cm^{-1}C^{-1}$ at 1150° C. Vapor compressibility measurements are presented in tabular form, and compared with values computed from the virial equation of state. Design study of equipment for further determination of the specific heat of K vapor have been concluded. Based on the best estimates of the properties of potassium vapor, it is reported that a dynamic, bare-wire probe appears to be suitable for measuring the thermal conductivity of K vapor. M.W.R.

N65-27423# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
DILUTE SOLUTION PROPERTIES OF HIGH-MOLECULAR-WEIGHT POLY (ISOBUTYL METHACRYLATE). IV: LIGHT SCATTERING STUDIES
Richard J. Valles Apr. 1965 50 p refs
(TR-3224; AD-463909)

High-molecular-weight poly (isobutyl methacrylate) was obtained from Edgewood Arsenal, Edgewood, Maryland. Fractionation of the original material was accomplished by repeated precipitation from dilute solutions in acetone using methanol as the nonsolvent. The viscosities were found to be shear dependent. The original light scattering experiments were run in methyl ethyl ketone, but were unsuccessful. The next experiments were run in acetone, and we were able to successfully measure the turbidity of the solutions at angles of 15°, 20°, and 25°. The relationship between molecular weight and intrinsic viscosity was established for poly(isobutyl methacrylate) in acetone at 25° C and in methyl ethyl ketone at 20° C, 25° C, 30° C, and 44° C. The dependence of the radius of gyration and root-mean-square end-to-end distance on the molecular weight was determined in acetone. The variation of the second virial coefficient with molecular weight and with the wavelength of light was also studied. Author

N65-27466# Sandia Corp., Albuquerque, N. Mex.
KINETICS OF THE REACTIONS BETWEEN FOUR VALENT URANIUM AND THE VARIOUS VALENCE STATES OF NEPTUNIUM
J. O. Wear, N. K. Shastri, and E. S. Amis (Arkansas Univ.) May 1965 69 p refs
(SC-RR-65-219) CFSTI: $3.00

The kinetics of the oxidation of U(IV) by various valence state of neptunium in aqueous-perchlorate and aqueous-chloride media has been presented. The work of Sullivan *et al.* on the Np (VI)–U(IV) reaction in aqueous-perchlorate medium has been reviewed. Original data and interpretations have been presented for the following systems: $Np(V)–U(IV)–ClO_4^- – H_2O$; $Np(V)–U(IV)–Cl^- – H_2O$; $Np(IV)–U(IV)–ClO_4^- – H_2$; and Np(IV)–U(IV)–Cl $–H_2O$. The specific velocity constants and activation energies have been determined for all of the paths involved in the various mechanisms. The Np(V)–U(IV) system has been explained by use of the Np(IV)–U(IV) system with very good agreement. Author

N65-27469# Societe Francaise de Chimie-Physique, Paris
CHEMICAL METHODS FOR THE STUDY OF FREE RADICALS [LES METHODES CHIMIQUES D'ETUDE DES RADICAUX LIBRES]
J. B. Donnet and L. A. Libis Brussels, EURATOM, 1965 21 p refs Presented at Ann. Meeting on Polyatomic Radicals, Bordeaux, Jul. 1964 In FRENCH; ENGLISH summary
(Contract EURATOM-030-62-6RISF)
(EUR-2216.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

Radiochemical methods for the determination of free radicals consist in trapping the radicals by means of suitable reagents and then tracing either the disappearance of the reagent or the appearance of a compound obtained by the reaction of the trapping substance with the free radicals. A description is provided of the advantages afforded by chemical over physical methods. In this work, the methods are classified according to the phase in which the radicals exist. With regard to solid state determinations, an account is given of the results obtained with a

method using C^{14}-marked radicals. This technique appears to be highly useful in particular cases of free radicals or active surface sites of solids capable of combining with free radicals. Author

N65-27528# Polytechnic Inst. of Brooklyn, N. Y.
COMPOUNDS WITH DEFECT STRUCTURES Progress Report, 1 Oct. 1964–31 Mar. 1965
E. Banks, M. Goldblatt, E. Kostiner, V. Abbruscato, and H. A. R. Wegener [1965] 12 p refs
(Contract DA-31-124-ARO(D)-71)
(PR-3; AD-465645)

Studies were carried out to determine the structure and other properties of several compounds. Spodiosite (Ca_2CrO_4Cl), with a calculated X-ray density of 3.216, was found to have unit cell dimensions of a = 6.227 Å, b = 7.143 Å, and c = 10.950 Å. There are four molecules per unit cell, and one molecule per asymmetric unit. After the heavy atom positions were calculated by computer, a three-dimensional Fourier synthesis was calculated on the IBM-7090. From this it was possible to deduce the position of the atoms. Additional calculations found the bond angles around chromium to be between 104.47 and 119.17 degrees. Crystals having the bixbyite structure, $(Fe,Mn)O_3$, were grown by electrolytic methods, and studies were undertaken to determine the crystal chemistry of these oxides. Two samples of β-Mn_2O_3 doped with aluminum oxide gave the following formula: $Mn_{1.37}Al_{0.13}O_3$. Experiments with Fe–Mn compounds yielded two formulas: $Mn_{0.86}Fe_{1.16}O_3$ and $Mn_{0.79}Fe_{0.95}O_3$. The ESR spectrum of a YbF_3 doped CdF_2 crystal, charge compensated with NaF, showed absorption lines which were anisotropic in addition to those of cubic character. Studies are also underway on the semiconductivity and structure of AuTlTe. M.W.R.

N65-27557# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROPERTIES OF HIGHER PURITY ZIRCONIUM DIOXIDE
G. P. Kalliga and L. A. Lyutsareva 9 Apr. 1965 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Khim. i Khim. Tekhnol. (Moscow), v. 7, no. 1, 1964 p 106–110
(FTD-TT-64-1068/1+2; AD-614761)

The firing and certain physicomechanical properties of sintered stabilized ZrO_2 with a 99.5% basic oxide content were investigated. An increase in purity of initial ZrO_2 to a 99.5% content of basic oxide improves the physicomechanical properties of the material at high temperatures. The optimum amount of stabilizing oxide for ZrO_2 of higher purity is 10 mol.% of CaO or MgO, which under industrial calcining temperatures (1700 to 1750° C) assures total sintering of the material, sufficient degree of its stabilization, and the best physicomechanical properties. The stabilization of ZrO_2 with MgO assures better calcining of the material at low sintering temperatures (to 1700° C) and obtainment of calcined objects with much higher mechanical characteristics in comparison with ZrO_2 stabilized with CaO. TiO_2 and Al_2O_3 admixtures improve the sintering of ZrO_2 of higher purity during its stabilization with CaO, but reduce the heat resistant properties of the material, especially in the case of Al_2O_3. R.N.A.

N65-27570# India. Dept. of Atomic Energy, Bombay. Spectroscopy Div.
THE ROTATING DISC ELECTRODE TECHNIQUE FOR THE SPECTROGRAPHIC DETERMINATION OF NIOBIUM, TANTALUM AND TITANIUM IN ORES
A. P. D'Silva and L. C. Chandola 1964 11 p refs
(AEET(SPEC)8)

The rotating disc electrode technique has been applied to the spectrographic analysis of niobium oxide (1–70%), tantalum oxide (2–30%) and titanium oxide (0.5–5%) in ores. The sample is converted into solution by fusion with potassium bi-sulphate and dissolution in oxalic acid. Molybdenum is added as an internal standard. The spectrum is recorded on a large quartz spectrograph by utilising a spark source. Mo 2683.2 has been selected as an internal standard for the analysis lines Nb 2950.9, Ta 2685.1 and Ti 3252.9. The standard deviation is found to be less than 5%. Author

N65-27580# Naval Ordnance Lab., White Oak, Md. Chemistry Research Dept.
NEW ARYLOXY ALKOXYSILANES (I)
James V. Duffy and Porter W. Erickson 26 Jan. 1965 19 p refs
(NOLTR-64-204; AD-613936)

A total of ten new aryloxy alkoxysilanes have been synthesized that are potential glass fiber finish chemicals for several resin systems. These aryloxysilanes were prepared by the partial condensation reaction between resorcinol and the following silanes: β(3,4-epoxycyclohexyl)ethyl-trimethoxysilane, α-glycidoxypropyltrimethoxysilane, N,N bis(β-hydroxyethyl)-α-aminopropyltriethoxysilane, α-aminopropyltriethoxysilane, β-carbethoxyethyltriethoxysilane, vinyltriethoxysilane, vinyltris(β-methoxyethoxy)silane, α-methacryloxypropyltrimethoxysilane, 3-cyclohexenetriethoxysilane and allyltriethoxysilane. Author

N65-27589# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SETTLING-OUT OF COBALT FROM LEAN SOLUTIONS WITH SODIUM SULFIDE
Yu. A. Yablonskiy, V. I. Smirnov et al 26 Apr. 1965 13 p refs Transl. into ENGLISH from Tr. Ural'sk. Politekhn. Inst. (Sverolovsk), no. 134, 1963 p 46–53
(FTD-TT-65-390/1&2; AD-614405)

Sodium sulfide appears to be an inexpensive generally accessible reagent for the settling out of cobalt and nickel from manganese and iron contaminated sulfuric acid solutions, obtained in the process of hydrometallurgical treating of oxidized iron ores and other materials, containing cobalt. The processing of cobalt solutions with sodium sulfide allows to extract into the residue about 94–98% of cobalt and 86–98% of Ni. Settling out of cobalt and nickel with sodium sulfide appears to be a simultaneous operation of cleansing the cobalt from manganese, because the ratio Co:Mn changes from 0.1 in solution to 25–35 in concentrate. Proposed is a technology of applying sodium sulfide for the settling out of cobalt testing under semi-industrial conditions. Author

N65-27596# Maryland Univ., College Park.
AN INVESTIGATION DIRECTED TOWARD THE SYNTHESIS OF CYCLIC POLYPHENYLENES; THE CHEMISTRY OF 1, 3, 5-HEXATRIENE AND ITS DERIVATIVES; AND REACTIONS OF AMINES IN THE VAPOR PHASE OVER ALUMINA
G. Forrest Woods Wright-Patterson AFB, Ohio, ARL, Mar. 1965 59 p refs
(Contract AF 33(657)-7833)
(ARL-65-55; AD-615900)

The results of the synthesis of intermediates which will be utilized in the attempted syntheses of ring polyphenylenes are reported. Experimental procedures have been devised and preliminary work accomplished on an "all-meta-" hexaphenylene, an octaphenylene which contains both meta- and para-linkages, and a quinquephenylene which contains within the same molecule ortho-, meta-, and para-linkages. The possibility of migration of unsaturation through or across a benzene nucleus has been examined and tentatively it seems that this phenomena has taken place. The syntheses of the 1-,2-,3-chloro-1,3,5-hexatrienes have now been accomplished. The

geometrical configuration of the less stable isomer of 1,3,5-hexatriene has been established by a stereospecific synthesis. The catalytic deamination reaction which in a rather formal way parallels the dehydration of alcohols has been explored. The reaction is, however, much more complex. In addition to the elimination of ammonia (or methyl amines) along with the formation of an olefin the following types of reactions take place 1) Nitrile formation (dehydrogenation) 2) Carbon chain degradation and polymerization 3) Cyclization with aromatization.
Author

N65-27605# Research Triangle Inst., Durham, N. C. Camille Dreyfus Lab.
RADIATION INDUCED EMULSION POLYMERIZATION Technical Progress Report, 1 Feb.–30 Nov. 1964
V. T. Stannett Washington, AEC, 23 Dec. 1964 28 p refs
(Contract AT(40-1)-2513)
(TID-21683) CFSTI: $2.00

The status of research in the field of radiation induced emulsion polymerizations is reviewed. The preparation and properties of a number of polystyrene and polyvinyl acetate lattices are described. Radiation products are shown to have narrower particle size and molecular weight distributions than the corresponding chemically initiated products. Polyvinyl acetate lattices of high molecular weight were prepared by radiation initiation at 0°C. The geometrical isomerism of polyisoprene and the tacticity of polymethyl methacrylate were determined using infrared and nuclear magnetic resonance respectively. Polymers prepared by radiation at 0° and 60° C showed only the expected changes due to temperature.
R.N.A.

N65-27611# Bureau of Mines, Laramie, Wyo. Laramie Petroleum Research Center.
PURIFICATION, PURITY ESTIMATION, AND SPECTRA OF SOME ORGANIC DERIVATIVES OF FLUORINE, SILICON, BORON, AND ALUMINUM
T. C. Davis and J. C. Morris 1965 38 p refs
(Contract CSO-59-9; ARPA Order 24-59)
(BMI-RI-6633)

Nine organic derivatives of fluorine, silicon, boron, and aluminum were purified for thermodynamic studies using distillation, zone melting, and gas liquid chromatography. The unusual properties of these compounds required the development of special techniques for handling and purification. To determine purities of purified samples, new techniques for analyzing spectral data were developed.
Author

N65-27625# India. Dept. of Atomic Energy, Bombay. Metallurgy Div.
PILOT PLANT PRODUCTION OF NUCLEAR GRADE ZIRCONIUM SPONGE FROM INDIAN ZIRCON
C. V. Sundaram 1965 70 p refs
(AEET-201)

The process for the production of reactor grade zirconium sponge from zircon, in which the zirconium is present as the silicate, is made up of the following steps: (1) reaction of zircon with potassium silicon fluoride to form $K_2Zr(Hf)F_6$; (2) aqueous leaching of the sintered product to extract the water soluble $K_2Zr(Hf)F_6$, followed by crystallization to yield a crude double fluoride primary salt as feed for further purification; (3) removal of hafium and other impurities by multiple recrystallization of K_2ZrF_6; (4) conversion of the purified K_2ZrF_6 to zirconium hydroxide by addition of ammonia; (5) filtration, washing, and drying of the hydroxide and calcination of the hydroxide to oxide; (6) chlorination of the oxide to $ZrCl_4$; (7) reduction of the chloride vapor with molten magnesium; (8) vacuum treatment of the reduced zirconium for the removal of magnesium and magnesium chloride by distillation; (9) crushing and grading of the zirconium sponge and evaluation of the metal. The complete flow-sheet and pilot plant are described in detail. Also, the spectrographic analysis of the final product is discussed.
E.E.B.

N65-27649# Ohio State Univ. Research Foundation, Columbus.
STUDY OF EMISSION SPECTRA BY PHASE-DISCRIMINATION METHODS Scientific Report No. 4 (Final Report)
Fred P. Dickey and William H. Rogge Feb. 1965 81 p refs
(Contract AF 19(604)-6150)
(AFCRL-65-246; AD-615148)

It gives a detailed report on the emission spectrum of the OH radical in the regions of the fundamental and first overtone vibration-rotation bands. The observations were made using a high resolution prismgrating vacuum spectrometer. The strong background which results from water vapor emission was eliminated by using two flames together with a phase-discrimination method of detection. A cooled lead sulphide detector was used to observe the fundamental band in the region from 2600 cm^{-1} to 4000 cm^{-1}. Lines from the 1-0, 2-1 and 3-2 bands were observed. An uncooled lead sulphide detector was used to observe the first overtone band in the region from 5700 cm^{-1} to 7200 cm^{-1}. Lines from the 2-0, 3-1 and 4-2 bands were observed.
Author

N65-27653# Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Electrochemicals Dept.
STABILITY OF HIGH STRENGTH H_2O_2. Quarterly Report, Period Ending 31 Mar. 1965
[1964] 51 p refs
(Contract AF 04(611)-10216; ARPA Order 24)
(QR-2; AD-615036)

Stability tests were completed on samples of commercial stabilized 90% and 98% hydrogen peroxide at −60°, −30°, and 0° C in pyrex glass. Hydrogen peroxide maintained at 0° C or below is considered stable and storable with decomposition rates below 1 ±0.5 ppm per day. Electron paramagnetic resonance studies were conducted in a rapid flow mixing chamber to determine the rate constants for initiation and propagation reactions of a highly transient intermediate species. Ti^{+3} and Fe^{+2} ions were used to initiate the decomposition with methanol and ethanol added to follow the reaction course in detail. Attempts to excite hydrogen peroxide solutions by flash photolysis to follow growth and decay of transient species failed as the absorption spectra was hidden by the hydrogen peroxide. Attenuated total reflectance measurements were made on a perfluorosulfonic acid ion exchange membrane exposed to 90% hydrogen peroxide at 70° C. The membrane was attacked indicating that not all perfluro compounds are inert to 90% hydrogen peroxide.
R.N.A.

N65-27669# Harvard Univ., Cambridge, Mass. Mallinckrodt Chemical Lab.
THE MICROWAVE SPECTRUM AND STRUCTURE OF NITRIC ACID
A. Peter Cox and Jose M. Riveros (Bristol Univ.) [1964] 31 p refs Presented at the Ohio State Symp. on Mol. Struct. and Spectry., Jun. 1964
(Contract Nonr-1866(14))
(AD-610432)

The microwave spectra of five further isotopic species of nitric acid, $HO^{15}NO_2$, cis $HONO^{18}O$, trans $HONO^{18}O$, cis $HON^{15}O^{18}O$ and $DN^{15}O_3$, have been investigated. In the calculation of structure, particular consideration has been given to the use of ground-state moments of inertia in Kraitchman's equations for near-oblate planar molecules. This determination clearly demonstrates a 2° tilt of the NO_2 group away from the hydrogen atom. The NO_2 parameters are close to those found in a number of related molecules but there is some evidence that the cis NO bond in HNO_3 is slightly longer than

the trans NO bond. The NOH configuration is very similar to that found in formaldoxime. Author

N65-27670# Bureau of Mines, College Park, Md.
A COMPUTER PROGRAM FOR ELECTRON PROBE MICROANALYSIS
James D. Brown 1965 32 p refs
(BM-RI-6648)

The Bureau of Mines has written a computer program in FORTRAN to facilitate the calculation of concentrations from X-ray intensities in electron probe microanalysis. Philibert's absorption and Castaing's secondary fluorescence corrections are used; no atomic number correction is included. Background and dead time corrections are applied to the data before calculating the relative intensities. Data from any type of electron probe microanalyzer can be used with the program. Author

N65-27672# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
SOLID STATE ELECTRODIFFUSION IN BISMUTH
R. H. Moore Apr. 1965 10 p refs
(Contract AT(45-1)-1830)
(BNWC-67) CFSTI: $1.00

Results of measurements utilizing a technique of cooling the specimen during passage of electric current in an electrodiffusion solid state process for producing Po^{210} in quantity, indicate that it should be possible to increase the current density applied to bismuth specimen (recovered and recycled in the process) by a factor of two or three. Such force does not seem warranted in view of results obtained, since Po^{210} must be caused to concentrate rapidly at one end of the specimen. Even at such high current densities it does not appear at that run times can be shortened significantly. At 240 hr the loss of Po^{210} by radioactive decay reached the level of 5%. Therefore it is concluded that the process of electrodiffusion is useless for Po^{210} concentration and of little or no value as a purification technique when applied to bismuth. L.S.

N65-27679*# National Aeronautics and Space Administration, Washington, D. C.
ULTRAMICROANALYSIS BY MEANS OF THE MATTAUCH–HERZOG TYPE MASS SPECTROGRAPH
E. Watanabe, M. Naito, and T. Aoyama Jun 1965 65 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Tokyo), v. 67, no. 11, Nov. 1964 p 1778–1793
(NASA-TT-F-9345) CFSTI: HC $3.00/MF $0.75 CSCL 20F

The history and principles of the double monitoring type mass spectrometer developed by Mattauch and Herzog and others is reviewed. The device developed by the authors has a resolution of 5000. The electrical, vacuum and mechanical systems, as well as the various types of spark ionic sources are described. The methods of preparing metallic, nonmetallic, semiconductor and powder samples are described. Methods of obtaining good spectra for various ions are given. Author

N65-27682*# National Aeronautics and Space Administration, Washington, D. C.
INTERACTION OF REFRACTORY COMPOUNDS WITH MOLTEN METALS [VZAIMODEYSTVIYE TUGOPLAVKIKH SOYEDINENIY s RASPLAVLENNYMI METALLAMI]
G. A. Yasinskaya (Acad. of Sci. Ukrain. SSR) May 1965 7 p refs Transl. into ENGLISH from Ogneupory (Moscow), no. 2, 1965 p 20–23
(NASA-TT-F-9375) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The interaction of refractory compounds such as carbides, borides, nitrides, and silicides in contact with molten metals (Cu, Mg, Fe, Co, Ni, Si, Cs, Zr, etc.) is discussed and tabulated for four groups, classified by degree of interaction. TiN, ZrN, BN, and ZrB_2 showed no interaction, making them suitable for prolonged contact. Author

N65-27685*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF THE CHEMICAL NATURE OF HUMIC ACIDS (HYDROLYSIS OF HUMIC ACIDS AND EXPRESS METHODS FOR DETERMINING THE FUNCTIONAL GROUPS) [ISSLEDOVANIYE CHIMICHESKOY PRIRODY GUMINOVYKH KISLOT (GIDROLIZ GUMINOVYKH KISLOT i USKORENNYYE METODY OPREDELENIYA FUNKTSIONAL'NYKH GRUPP)]
Jun. 1965 15 p refs Transl. into ENGLISH from Pochvovedeniye (Moscow), no. 3, 1950 p 151–157
(NASA-TT-F-9383) CFSTI: HC $1.00/MF $0.50 CSCL 06K

Humic acids derived from peat and two soil types have been subjected to acid hydrolysis to determine the structural modifications induced by acid hydrolysis; the functional groups have been determined in both hydrolized and nonhydrolized humic acids by several techniques, including a rapid method developed by the authors, which in comparison with longer conventional methods discloses fair reliability. Principally, the average carbon-nitrogen ratio and bond between the humic acid molecules and nitrogenous compounds are affected by hydrolysis. Author

N65-27697# Little (Arthur D.), Inc., Cambridge, Mass.
THE ELECTRICAL CONDUCTIVITY AND STRUCTURE OF AQUEOUS MAGNESIUM SULPHATE SOLUTIONS IN THE −2 TO +12°C RANGE
R. A. Horne and D. S. Johnson 31 Jan. 1965 20 p refs Submitted for Publication
(Contract Nonr-4424(00))
(TR-7; AD-610518) CSCL 07D

The electrical conduction of aqueous 0.001, 0.01, and 0.1 $MgSO_4$ solutions has been measured over the range −2 to +12°C. The activation energy of electrical conduction of aqueous $MgSO_4$ solutions, unlike those of solutions of "normal" strong 1:1 electrolytes, does not exhibit a maximum near the temperature of maximum density. The local water structure near $MgSO_4$ is so strong and extensive that structural changes in the more remote bulk water have little effect on transport processes involving $MgSO_4$. The mechanism of this process apparently resembles that of viscous flow in water rather than "normal" ionic electrical conduction. Author

N65-27698# Naval Research Lab., Washington, D. C. Inorganic and Nuclear Chemistry Branch.
FILTRATION OF SALT SMOKE FROM CHLORATE CANDLE OXYGEN Interim Report
S. H. Smith, J. K. Musick, and R. R. Miller 11 Feb. 1965 8 p ref
(NRL-6216; AD-612185) CFSTI: $0.50

Filtration of a sodium chloride aerosol in high concentration proved to be a continuing problem during the development of chlorate oxygen candles and their associated equipment for use on submarines. Rockwool-wire mesh combinations were first used in welded assemblies which were cleaned by water washing when they became clogged. The rockwool was later replaced with fiberglass blanket, and two modifications of the assembly were made, but the filter use remained inconvenient because of inadequate salt capacity. A progressive step proved to be alteration of the assembly to use a throwaway fiberglass element and elimination of the washing operation. Further improvement was made possible by use of a woven replaceable fiberglass sleeve. The recently constructed assembly incorporating woven sleeve elements is to be subjected to sea trials as soon as possible. Author

N65-27706*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF NUCLEAR RADIATION ON THE PROPERTIES OF REFRACTORY COMPOUNDS [VLIYANIYE YADERNYKH IZLUCHENIYNA SVOYSTVA TUGOPLAVKIKH SOYEDINENIY]
I. D. Konozenko and V. S. Neshpor Jun. 1965 20 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), no. 1, 1965 p 60–70
(NASA-TT-F-9412) CFSTI: HC $1.00/MF $0.50 CSCL 07E

The effect of nuclear radiation on the microstructure, elementary-cell dimensions, hardness, and electric conductivity of titanium, molybdenum, and silicon carbides as well as of gadolinium hexaboride is discussed, with photomicrographs, resistivity curves, and tabulated data. Structurally equivalent crystal lattices with strong interatomic bonds are most resistant to neutron irradiation. Microhardness was increased to various degrees, except for silicon carbide which also showed the lowest defect formation but underwent a greater change in resistivity. Author

N65-27723*# National Aeronautics and Space Administration, Washington, D. C.
SYNTHESES USING ACETYLENE (PRELIMINARY REPORT) [SINTEZY s POMOSHCH'YU ATSETILENA. PREDVARITEL'NOYE SOOBSHCHENIYE]
A. Ye. Chichibabina Jul. 1965 17 p refs Transl. into ENGLISH from Zh. Obshch. Khim. (Moscow), v. 47, 1915 p 703–713
(NASA-TT-F-9446) CFSTI: HC $1.00/MF $0.50 CSCL 07C

A summary is given of past experiments on acetylene condensation reactions. In his own experiments the author finds that acetylene can be formed during various types of acetaldehyde condensation from acetylene by eliminating water. It is found that acetylene condensation reactions and acetaldehyde condensation reactions are very similar. Author

N65-27760# Mithras, Inc., Cambridge, Mass.
STUDIES OF THE EFFECT OF LASER RADIATION ON CHEMICAL ACTIVATION AND VAPOR FOG NUCLEATION
Quarterly Progress Report No. 1, Jun.–Sep. 1964
Charles S. Naiman, Mary Yvonne De Wolf, and Jack Schwartz Nov. 1964 15 p refs
(Contract DA-18-035-AMC-255(A))
(MC-64-110-RI; AD-610517)

The first objective is the study of various effects of laser radiation upon vapor and liquid systems comprised of, but not limited to, the simulant dimethyl methylphosphonate (DMMP) or air components or both. The second objective is to obtain basic information on the condensation of vapor or aerosol fogs as a result of laser radiation. The chemical shifts, coupling constants, and relaxation times of the methyl and methoxy protons in DMMP have been measured by nuclear magnetic resonance (NMR) techniques. Effects of focused and unfocused, Q-switched and non-Q-switched laser radiation on methanol vapor in a continuously sensitive cloud chamber have been studied. A much less intense laser beam can produce condensation by incidence on a suitable surface than is required to produce tracks directly with a focused beam. A cloud chamber has been tested with low vapor pressure materials, such as water, to determine the modifications that are necessary, in order to study DMMP in the cloud chamber. Author

N65-27783# Bureau of Mines, Rolla, Mo. Rolla Metallurgy Research Center.
THERMAL DECOMPOSITIONS OF SIDERITE AND CONSEQUENTIAL REACTIONS
H. E. Powell 1965 47 p refs
(BM-RI-6643)

Basic data were recorded on the decompositions that take place during thermal decomposition of siderite ($FeCO_3$). Both the naturally occurring and a synthetically prepared mineral were studied by differential thermal, thermogravimetric, X-ray-diffraction, and chemical (including gas) analyses. Thermal decomposition was studied in the media of dry air, moist air, dry carbon dioxide, dry helium, and dry carbon monoxide and at atmospheric and at reduced pressures. Results showed the thermal decomposition of $FeCO_3$ to be an extremely complex process, dependent on environmental factors and side reactions that cannot now be completely controlled. Author

N65-27785# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
IDENTIFICATION OF CARBIDES, NITRIDES, AND OXIDES OF NIOBIUM AND NIOBIUM ALLOYS BY ANODIC STAINING
R. S. Crouse Jul. 1965 13 p
(Contract W-7405-ENG-26)
(ORNL-3821) CFSTI: $1.00

A method was developed for the identification of some impurity phases in niobium and niobium alloys. It is based on the principle that an anodic oxide film formed on niobium produces interference colors. The color is characteristic of the anodic oxide thickness which in turn depends upon the composition of the substrate. These color differences can be used to identify carbides, nitrides, and oxides. Using specimens containing known phases, a technique was developed to identify these phases in unknown specimens. Weak solutions of organic acids were found to be the most satisfactory electrolytes for anodization, although other electrolytes can be used. Clear colors were produced and good control was possible with individual solutions of lactic, citric, and oxalic acids, or mixtures of these. Author

N65-27787# Atomic Energy of Canada, Ltd., Chalk River, Ontario.
FLAME-IN-TUBE ATOMIC ABSORPTION SPECTROPHOTOMETRY: THE DETERMINATION OF IRON IMPURITY IN TERPHENYL REACTOR COOLANT
J. P. Mislan and S. J. Mark Feb. 1965 18 p refs
(AECL-2228; CRDC-1216) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

This report describes the application of atomic absorption spectrophotometry to the determination of iron impurity in terphenyl reactor coolant. A flame-in-tube sampler unit was designed and constructed specifically for this analysis. A description is given of the instrumentation and analytical procedure. The detection limit for iron in the coolant was found to be 0.10 ppm. A comparison is made between the atomic absorption analysis and the X-ray fluorescence method now in routine use. Author

N65-27794# Air Force Systems Command, Wright-Patterson AFB, Ohio. Elastomers and Coatings Branch
THE PHOTOCHEMICALLY INDUCED FRIES REARRANGEMENT OF AROMATIC ESTERS, 1 JANUARY 1962–1 SEPTEMBER 1963
James J. Mattice (M.S. Thesis—Ohio State Univ., 1963)
Dec. 1964 43 p refs
(ML-TDR-64-170; AD-610403)

This investigation involved aryl esters for which a photochemical rearrangement had not previously been reported. Results of the photolysis of eight aromatic benzoates (phenyl, p-tolyl, p-chlorophenyl, phenyl p-chloro, 2,6-dimethylphenyl, mesityl, and phenyl mesitoate) are presented. Ortho- and para-hydroxybenzophenones are formed in cases where structural

considerations permit, as well as products which, in certain instances, could not be identified. The photo-reaction has also been studied in two examples in the ferrocene series. An unexpected preference for formation of para-hydroxyketone is observed. The photo-Fries reactions investigated are discussed on the basis of the products formed and in comparison with related work in the current literature. Possible intermediates and mechanisms which might account for the observed reactions are pointed out and suggestions for future experimental work outlined. Author

N65-27797# American Cyanamid Co., Stamford, Conn. Central Research Div.
CHEMILUMINESCENT MATERIALS, SEPTEMBER 1–NOVEMBER 30, 1964
M. M. Rauhut, L. J. Bollyky, D. Sheehan, R. A. Clarke, A. M. Semsel et al [1964] 55 p refs
(Contract Nonr-4200(00); ARPA Order 299)
(TR-6; AD-610435)

Studies of processes involved in chemiluminescence are reported. Quantitative luminosity and brightness data are summarized for representative luminol and oxalyl chloride chemiluminescent systems. Investigations of oxalyl peroxide chemiluminescent systems indicate that acyl-oxalyl peroxides are unstable. An exploratory synthesis effort to provide new chemiluminescent reactions from mechanistic hypotheses produced four new chemiluminescent reactions based on acridine and dihydroanthracene peroxides. Reactant concentration effects on quantum yields of light emission in the oxalyl chloride–hydrogen peroxide–9, 10–diphenylanthracene system were studied. J.M.D.

N65-27820*# General Electric Co., Philadelphia, Pa.
STUDY OF THE GROWTH PARAMETERS INVOLVED IN SYNTHESIZING BORON CARBIDE FILAMENTS
A. Gatti, C. Mancuso, E. Feingold, R. Mehan, and R. Cree Washington, NASA, Jul. 1965 64 p refs
(Contract NASw-937)
(NASA-CR-251) CFSTI: HC $3.00/MF $0.75 CSCL 07B

This program is a continuation of a study concerned with (1) the synthesis of boron carbide whiskers, (2) the characterization of these whiskers in terms of their chemical and physical properties at room and elevated temperatures, and (3) the utilization of such whiskers in composite. In the present investigation, emphasis is placed on (1) the scale up to B_4C whisker production, (2) the testing of individual whiskers at elevated temperatures, and (3) the fabrication and testing of composites containing these whiskers. N.E.A.

N65-27831*# American Univ., Washington, D. C.
INVESTIGATION OF ELECTROCHEMISTRY OF HIGH ENERGY COMPOUNDS IN ORGANIC ELECTROLYTES, NOVEMBER 1, 1964–APRIL 30, 1965
R. T. Foley, J. S. Swinehart, and L. Schubert [1965] 47 p refs
(Grant NGR-09-003-005)
(NASA-CR-63741) CFSTI: HC $2.00/MF $0.50 CSCL 07D

The investigation of high energy compounds in organic electrolytes is proceeding along two lines. The first involves the study of the electrochemical properties of six solvents selected because of their reported physical and chemical properties. These are acetonitrile, dimethylformamide, α-picoline, propylene carbonate, γ-butyrolactone, and γ-valerolactone. Solutions of butyrolactone have decomposition potentials exceeding 4 volts and are greatly dependent on the supporting electrolyte. Dimethylformamide solutions have decomposition potentials greater than 5.5 volts if easily reducible species are not introduced, e.g. by drying procedures. The second effort involves the study of high energy cathodic compounds, popularly known as "depolarizers". Attention is being devoted to the nitrogen-halogen compounds on the basis of their reported high potential and high capacity, and their expected suitability for nonaqueous systems. Author

N65-27832# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
THE STRUCTURE OF PHYLLALBINE. APPLICATION OF MAGNETIC NUCLEAR RESONANCE AND MASS SPECTROMETRY TO THE STUDY OF TROPANE DERIVATIVES
Joseph Parello, Pierre Longevialle, Walter Vetter, and James A. Mc Closkey May 1965 17 p refs Transl. into ENGLISH from Bull. Soc. Chim. France (Paris), no. 12, Dec. 1963 p 2787–2793
(RSIC-411; AD-616337)

Phyllalbine is the vanillic ester of tropanol. The chemical determination of this structure is completed by a study of some tropanol and pseudotropanol derivatives by means of magnetic nuclear resonance (RMN) and mass spectrometry. Author

N65-27844# Utah State Univ., Logan. Electro-Dynamics Labs
CHEMILUMINESCENCE FROM ATMOSPHERIC GAS REACTIONS Final Report
W. M. Moore, J. P. Kennealy, and D. J. Baker 1 Jan. 1965 44 p refs
(Contract AF 19(628)-3821; ARPA Order III; Proj. Defender)
(AFCRL-65-291; AD-616335)

Chemical reactions involving active nitrogen and oxides of nitrogen have been studied with the relatively new technique of infrared chemiluminescence. Spectra have been obtained and presented of the N + NO reaction from 1 to 6 microns. First overtone emissions of nitric oxide at 2.7 microns have been obtained from the reaction of N + NO_2 and the intensity variations studied as a function of NO_2 concentration. Equilibrium between the vibrational and rotational modes has not been achieved. The rotational temperature is only several hundred degrees, whereas the vibrational temperature is several thousand degrees. This reaction shows similarities to the H + Cl_2 reaction studied by Polanyi In addition to energy transfer information, this reaction shows that infrared chemiluminescence can yield valuable information about the mechanism of complex chemical reactions. Author

N65-27861# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.
SOLUTION AND CONDUCTIVITY STUDIES OF FLUORINE-CONTAINING OXIDIZERS Quarterly Progress Report, 15 Mar.–15 Jun. 1965
M. S. Toy, W. A. Cannon, and W. D. English [1965] 29 p refs
(Contract DA-31-124-ARO(D)-115; ARPA Order 470)
(Rept.-144-08; AD-465126)

This report summarizes the results of solution and conductivity studies of fluorine-containing oxidizers. In a search for electrode materials in halogen fluoride electrolytes, eighteen metals have been investigated. The oxidation potentials of metals in bromine trifluoride, polarization curves of potential electrodes, discharge characteristics of electrolytic cells are reported as functions of temperatures and concentrations. The power density outputs of cells with different electrodes and electrolytes have been estimated. The feasibility of an electrolytic cell using halogen fluorides as electrolytes has been established. Author

N65-27870# Naval Radiological Defense Lab., San Francisco, Calif.
ION-EXCHANGE PROCESSES BETWEEN IMMISCIBLE MOLTEN PHASES

R. C. Scheidt and E. C. Freiling 18 Apr. 1965 14 p refs
(Contract AT(49-2)-1167)
(USNRDL-TR-847; AD-465063)

To test the hypothesis that cation distribution in (alkali oxide)-(boron oxide)-(alkali halide) systems occurs by ion-exchange processes, some definitive experiments were devised and carried out. The experiments consisted of equilibrating Na^{22}-labelled sodium borate with KCl at 830° C. Higher concentrations of K^+ than Cl^- in the borate phase and Na^+ than BO_2 in the salt phase established the operation of cation-exchange processes in the immiscible molten system. Author

N65-27878*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Material Sciences Lab.
ELECTROLYTIC PREPARATION OF HIGH DIELECTRIC FILMS Quarterly Report No. 3, Feb. – May 1965
A. E. Hultquist and M. E. Sibert [1965] 15 p
(Contract NASw-969)
(NASA-CR-63746; Y-76-65-1) CFSTI: HC $1.00/MF $0.50
CSCL 07B

Niobium, tantalum, titanium, and zirconium were used to prepare high dielectric materials in thin film form on refractory metal substrates by electrochemical techniques. The ethylenedianimetetracetic (EDTA) bath is obtained by mixing a solution of H_3BO_3, KOH, NaEDTA with a solution of the metal acetate, either Ba, Ca, Sr, or Ba-Sr. Analyses of film composition were made by semiquantitative spectrographic methods. It was found that major amounts of Group II metals can be occluded in an anodic film on Nb, Ti, and Zr, and that the concentration of Ba is a function of anodization time. There was an absence of Sr on the film. When samples of the Zr films prepared in the Ca bath were analyzed by X-ray diffraction, both heat treated and as-produced samples were crystalline; heat treatment caused a few lines to disappear, but others to appear. The electrical properties of capacitance, dissipation factor, and resistance have been measured for the electrochemical conversion films; and the reproducibility, effect of bath type, and anodization time have been determined using as-produced films. M.W.R.

N65-27886# Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
CHELATE WATER SOLUTION LASERS Final Technical Summary Report, 1 Jul.–31 Dec. 1964
E. P. Riedel and R. G. Charles [1964] 72 p refs
(Contract Nonr-4573(00); ARPA Order 306; Proj. Defender)
(AD-610714)

Heavy water is considered as a liquid laser solvent. Its unique combination of good optical homogeneity, low absorption at the laser output frequency and low viscosity make it very attractive for proposed high radiance liquid laser systems. The heavy water soluble rare-earth chelate research at the Westinghouse Research Laboratories both before the start and during the present contract is described. Chelates having adequate solubility, high quantum efficiency and improved absorption bands have been developed. The work with europium benzoyltrifluoroacetonate both before and after the end of the present contract is described. To date, laser action has been achieved in 10 salts of this compound in acetonitrile near room temperature. Output beam divergence, spectral narrowing and thresholds for laser action are discussed. Author

N65-27896# Illinois Univ., Urbana. Materials Research Lab.
MATERIALS RESEARCH LABORATORY ANNUAL TECHNICAL REPORT, 1964–1965
May 1965 104 p refs

Materials research projects are presented and include enthalpy changes in athermal solid state transformations, condensed state of matter theory, electronic specific heat of transition element alloys, structural changes in glass systems during crystalline phase nucleation, point defect, excited defect states, electronic properties, and color centers of ionic crystals, nuclear analytic methods, high pressure for studying the structure of matter, vibration-rotation spectroscopy of molecules trapped in rare gas lattices, conduction mechanisms in semiconducting glasses, anharmonic effects and mechanical and surface behavior of solids, properties and tunneling measurements of superconductors, surface physics and semiconductors, junction effects in compound semiconductors, low temperature thermal conductivity, radiation damage, dislocations and surface barriers, magnetocircular dichroism, diffusionless phase changes, annealing cold worked metals, electron and nuclear magnetic resonance, solid state electronics, high magnetic field superconductivity, noble gas crystal properties, and paramagnetic relaxation and dynamic nuclear polarization. R.N.A.

N65-27911# Monsanto Research Corp., Dayton, Ohio.
DEVELOPMENT OF FIRE-RESISTANT WATER BASE HYDRAULIC FLUID Bimonthly Report, 1 Dec. 1964–31 Jan. 1965
E. S. Blake, G. F. Deebel, and G. A. Richardson [1965] 17 p
(Contract NObs-90270)
(BMR-5; AD-610674)

The broad objective of this contract is the development of a usable, fire-resistant water-base hydraulic fluid for shipboard use, in which the nonaqueous phase is fire-resistant. The alkali alkyl phosphates continue to afford the optimum properties as pour point depressant candidates. Introduction of a phenyl moiety into the ethyl group raised the AIT to 900° F. Of the commercially available thickener's tested, Cellosize hydroxyethyl cellulose (WP4400) and WSR 205 were of interest as thickeners. The low percentages suggest that from a sheer stability standpoint they may be suspect. The AIT of phosphates appears unaffected by large amounts of water. Author

N65-27913# Bureau of Mines, College Park, Md.
COLLEGE PARK METALLURGY RESEARCH CENTER. CALCULATION OF ADSORPTION ENERGY
Foster Fraas 1965 18 p refs
(BM-RI-6639)

The Bureau of Mines investigated a method for calculating values of adsorption energy; the goal was to devise an equation consistent with experimental data accumulated in the investigation of adsorption as related to ore separation processes. Numerical identification of the constants of a previously formulated equation provided an equation by which values of adsorption energy could be calculated. Values thus calculated checked with those obtained by calorimetric measurement. Author

N65-27915# Union Carbide Nuclear Co., Oak Ridge, Tenn. Chemical Development Dept.
CALCULATION OF THE DENSITY AND VISCOSITY OF SUCROSE SOLUTIONS
E. J. Barber 24 Jun. 1965 43 p refs
(Contract W-7405-ENG-26)
(K-1635) CFSTI: $2.00

Equations have been developed which permit the calculation of the density and viscosity of sucrose solutions as functions of the composition for use in computer programming of the calculation of sedimentation coefficients. A 9-constant empirical equation expressing the density as a function of the weight fraction sucrose and the temperature is recommended for the temperature range of 0 to 30° C. and a concentration range of 0 to 75 per cent sucrose. For use in the calculation of density

between 30° and 60° C, and from 0 to 70 weight per cent sucrose, a theoretically based empirical equation with six adjustable constants is recommended. An Antoine or modified Arrhenius equation was used to correlate the viscosity data of the National Bureau of Standards as a function of the mole fraction sucrose over the temperature range of 0 to 80° C, and the concentration range from 0 to 75 weight per cent sucrose. Author

N65-27920# National Academy of Sciences—National Research Council, Washington, D. C.
RADIOCHEMISTRY OF RHODIUM
James C. Armstrong, Jr. (Florida State Univ.) and Gregory R. Choppin (Hazelton Nuclear Science Corp.) Washington, AEC, May 1965 82 p refs
(NAS-NS-3008(Rev.)) CFSTI: $1.00

This monograph is a revised and expanded version of an earlier publication. Reviews of nuclear and chemical properties of rhodium, discussions of methods of sample dissolution and of separation reactions, descriptions of counting techniques, and a compilation of radiochemical separation procedures are included. A bibliography on the separation of rhodium and general references on the inorganic and analytical chemistry of this element are also presented. The main subdivisions of the monograph are: *Isotopes of Rhodium; Review of the Chemistry of Rhodium; Separation Chemistry; Biological Aspects of Rhodium; Activation Analysis; Counting Techniques;* and *Collection of Detailed Radio-Chemical Procedures.* E.E.B.

N65-27941# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
DETERMINATION OF SUBMICROGRAM QUANTITIES OF MERCURY IN LITHIUM METAL, ITS HYDRIDE, OR HYDROXIDE
W. C. Dietrich 7 Jul. 1965 25 p refs
(Contract W-7405-ENG-26)
(Y-1482) CFSTI: $2.00

A method has been developed for determining submicrogram quantities of mercury in lithium metal, lithium hydride, or lithium hydroxide. Mercury was concentrated as the dithizonate from an acetate system by a dithizone-chloroform extraction, then determined spectrophotometrically as liberated dithizone after dissociating the mercury dithizonate with potassium iodide. Author

N65-27951°# Pittsburgh Univ., Pa. Dept. of Physics.
IONOSPHERIC REACTION RATES IN THE LIGHT OF RECENT MEASUREMENTS IN THE IONOSPHERE AND THE LABORATORY
T. M. Donahue 27 May 1965 39 p refs *Its* SSRC Rept.-5
(Contract NASr-179)
(NASA-CR-63763) CFSTI: HC $2.00/MF $0.50 CSCL 04A

An attempt is made to obtain sets of ion-molecule reaction rates and recombination coefficients consistent with recent mass spectrometric ion data between 120 and 220 km. It is found that recently measured rates of 3×10^{-12} cm^3/sec for formation of NO^+ from $O^+ + N_2$ and 4×10^{-13} cm^3/sec for charge exchange in $N_2^+ + O_2$ require that the rate of formation of NO^+ in the $N_2 + O$ reaction be larger than 5×10^{-10} cm^3/sec at 300°. Daytime conditions are susceptible to explanation with a wide range of possible rates. The observations require that the dissociative recombination coefficient for NO^+ decrease from 5×10^{-7} cm^3/sec at 300° as $T^{-3/2}$ and for O_2^+ decrease from 3.5×10^{-7} cm^3/sec as $T^{-2/3}$. The nighttime ionosphere can be explained with the same recombination coefficients. The nocturnal NO^+ maximum in the E region then requires an ionization of N_2 at the rate of 6–10 ion pairs/cm^3 sec. N_2^+, O_2 charge exchange reaction must be slow and the N_2^+ O ion atom interchange reaction rapid unless NO^+ production from N_2^+, O_2 and O_2^+, NO reactions is efficient. A source of ionization is also required above 180 km to explain the appearance of N_2^+ at night. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-26671 Observatoire de Paris (France).
USE OF RADIO TIME SIGNALS FOR RELATING MEASUREMENT STATIONS OVER LONG DISTANCES [UTILISATION DES RADIO-SIGNAUX HORAIRES POUR LE RATTACHEMENT A GRANDE DISTANCE DES STATIONS DE MESURES]
Pierre Parcelier *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. I [1964] p 223–227 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

Radio time signals are a means to compare local times of measuring stations located far apart. A phenomenon which is received simultaneously by these stations can be dated on a common time scale; this makes it possible to measure time intervals. By means of suitable instruments, each station determines the correction of its local time by comparison with radio time signals, the reception of which are not necessarily simultaneous. The radio time signals which are used can be on different but uniform time scales. Experiments which have been performed between Africa (Sahara) and Europe (Paris and Meudon) by means of European and American time signals have yielded a precision of 0.1 msec. Author

N65-26935# Raytheon Co., Santa Barbara, Calif. Space and Information Systems Div.
FEASIBILITY STUDY OF ANTENNA TECHNIQUES INCORPORATING UNIDIRECTIONAL DEVICES AS FUNCTIONAL ELEMENTS Interim Engineering Report, 1 Dec. 1964–1 May 1965
M. J. Bock and G. E. Malby Wright-Patterson AFB, Ohio, AF Avionics Lab., 15 May 1965 40 p refs
(Contract AF 33(615)-1256)
(IER-3; AD-463165)

Two methods of achieving phase control on a slot have been analyzed and evaluated. The feasibility of controlling the phase on a slot by mechanically displacing the center of radiation of the slot has been demonstrated and work is continuing in an effort to increase the present magnitude of phase control obtained with varactors. The feasibility of controlling the phase on a slot with a varactor-controlled feed-backup short has also been demonstrated. A model of the multipolarization nonlinear mixer antenna has been fabricated and measurements show that the mixer responds to all polarizations with a 6 db total variation between the maximum and minimum response of the mixer to any polarization. Author

N65-26942# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SPACE COMMUNICATIONS Division 6 Quarterly Progress Report, 1 Sep.–30 Nov. 1964
Gerald P. Dinneen et al 15 Dec. 1964 34 p refs
(Contract AF 19(628)-500)
(AD-461635)

Space communications activities, antenna system investigations, and space probe work are reviewed. Progress is reported on research dealing with RF components, surface and space techniques and equipment, radio physics, radar, engineering, and various analytical studies. M.W.R.

N65-27050*# Stanford Research Inst., Menlo Park, Calif.
CODES AND CODING CIRCUITRY FOR AUTOMATIC ERROR CORRECTION WITHIN DIGITAL SYSTEMS Technical Report No. 2
William H. Kautz Jan. 1962 55 p refs Prepared for JPL
(Contracts NASw-6; JPL-M-44501)
(NASA-CR-63519) CFSTI: HC $3.00/MF $0.50 CSCL 09D

Error-correcting codes for use in communication channels have been known for many years. Recently discovered code families have enabled economical encoding and decoding equipment to be designed for use with even very noisy channels. These new codes provide for the automatic correction of several independent errors in a block of transmitted digits, or of bursts of errors in successive digits. Within a digital computer the "channel" becomes the collection of data paths and storage locations embodied in index, data, and control registers and in the memories and associated input-output transfer links. An attempt to apply existing error-checking codes to this type of channel reveals that these known codes are not necessarily optimal, because (1) appropriate measures of efficiency may differ from those customary in the traditional communications channels, (2) the most probable types of errors (noise) may not be the same, (3) one must also take into account the possibility of errors due to faults in the decoding logic (corrector) itself, and (4) if possible, the codes should be compatible in some sense with arithmetic and other related operations. In this report we discuss the efficiency, cost, and optimality of codes for use within digital systems, and evaluate to what extent known code families can be applied to automatic error correction. To better satisfy these criteria in the most important remaining cases, some new codes are then described. Particular attention is devoted to error correctors which are "fault-masked"—i.e., whose performance is insensitive to single isolated circuit faults. Also discussed are the simplifications possible if mere detection of an error is adequate. Several examples of encoding, corrector, and detector circuits are offered, exemplifying the use of both gate-type and branch-type logical elements. Author

N65-27056*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRACKING SYSTEM DATA ANALYSIS REPORT, RANGER VII Final Report
A. L. Berman 1 Jun. 1965 93 p
(Contract NAS7-100)
(NASA-CR-63531; JPL-TR-32-719) CFSTI: HC $3.00/MF $0.75 CSCL 17I

This report is an analysis of the Deep Space Instrumentation Facility tracking performance during the Ranger VII mission. Included are ground system configurations, station view periods, and a discussion by station and view period of all tracking data, i.e., angular and doppler, taken by the tracking stations. A summary is given of the tracking data which were actually used to determine the spacecraft orbit and the noise statistics of these data. Author

N65-27071# Army Electronics Labs., Fort Monmouth, N. J. Exploratory Research Div. C.
A FORESHORTENED CENTER-FED WHIP ANTENNA
Watson P. Czerwinski Jan. 1965 24 p refs
(ECOM-2549; AD-611278)

An experimental investigation was conducted to determine whether the degradation in electrical performance commonly observed with reduced-height helical-wound vertical dipoles can be avoided. A new design approach has been explored which helped define a major cause of this degradation. Data obtained during this investigation supports a working hypothesis that losses associated with circulating currents in the capacitance between turns of a helically wound, electrically short vertical dipole reduce antenna bandwidth and efficiency. A six-foot-high experimental model was constructed and tested as a replacement for the 10-foot whip of Antenna AS-1729( )/VRC. The design of this foreshortened model minimized circulating current losses throughout the operating band of 30 to 76 Mc and resulted in an average efficiency of 90% compared to the 10-foot whip. Author

N65-27074# Radiation, Inc., Melbourne, Fla. Radiation Systems Div.
STUDY OF SPECIAL BEAMSHAPING ANTENNAS Five Month Report, 1 Oct. 1964–28 Feb. 1965
H. E. Bartlett, B. L. Lewis, L. Pietsch, and G. W. Collins [1965] 113 p refs
(Contract DA-28-043-AMC-00389(S))
(Rept.-6; AD-615020)

This Technical Report describes the progress during the first five months of a program to develop dielectric elements for use in lightweight, highly-transportable satellite communications antennas. Dielectric elements conceived and investigated on a previous contract were further investigated during the first five months of this program in order (1) to determine the dielectric element type most applicable to the transportable array problem and (2) to further reduce this element to useable hardware. The remaining portion of the program will consist primarily of the design, fabrication, and testing of an array model to demonstrate transportability features. The dielectric element investigations indicated that several types of dielectric elements are applicable. These elements were projected into possible array configurations which were evaluated and compared on the basis of transportability. As a result of these evaluations and comparisons, the reflector antenna with a Dielectric Cassegrain Feed has been found to be most applicable for use in highly-transportable systems and is more completely developed than the other dielectric element types. The Cylindrical Dielectric Antenna and the Dielectric-Loaded Reflector have been found to have some desirable characteristics for transportable applications. Author

N65-27087# Michigan Univ., Ann Arbor. Radiation Lab.
THE MINIMIZATION OF BACK SCATTERING OF A CYLINDER BY DOUBLE LOADING Scientific Report No. 4
Kun-Mu Chen Apr. 1965 37 p refs
(Contract AF 19(628)-2374)
(AFCRL-65-254; Rept.-5548-4-T; AD-615538)

A theory on the minimization of the back scattering of a cylinder by loading a cylinder at two points with lumped impedances is presented. The induced current on a doubly loaded cylinder when illuminated by a plane electromagnetic wave at an arbitrary angle is obtained. The optimum loading to eliminate the broadside back scattering which is caused by the symmetrical component of the induced current is established. A suitable loading to reduce the off-broadside back scattering, due to the antisymmetrical component of the induced current, is also

determined. A proper choice of the impedance and the position of double loading can lead to the reduction of the back scattering over a wide aspect range. The useful formulas for optimum loading and some graphical illustrations are included. The advantages of double loading over central loading are discussed. Author

N65-27090# Army Electronics Labs., Fort Monmouth, N. J. Communications Dept.
MONOCYCLE POSITION MODULATION
William A. Huber Apr. 1965 85 p refs
(ECOM-2576; AD-615965)

This report describes a new form of time position modulation designed to obtain an increase in the rate of transmission of binary digital data without extending the bandwidth. The system known as Monocycle Position Modulation (MPM) is described, and its application to the transmission of binary digital data is discussed. An inherent characteristic of the MPM signal is that it contains synchronizing information that has not required additional time or power to transmit. A method for extracting and using this synchronizing data at the receiver is given. This method uses a novel analog memory for frequency control that has both short time response under dynamic conditions and infinitely long time memory under static conditions. Another desirable characteristic of the memory is its ability to adapt to operational changes. An analysis of the spectral power distribution of a randomly modulated MPM signal is derived and the results interpreted with respect to system performance. The performance obtained during laboratory tests of an experimental MPM system operating directly from a binary digital signal stream at 3,000 bits/second is described. Author

N65-27124# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
TRANSMISSION LOSS PREDICTIONS FOR TROPOSPHERIC COMMUNICATION CIRCUITS, VOLUME 1
P. L. Rice, A. G. Langley, K. A. Norton, and A. P. Barsis 7 May 1965 171 p refs
(NBS-TN-101; Vol. I) GPO: $1.00

Methods for predicting cumulative distributions of transmission loss for a wide range of radio frequencies over any type of terrain and in several climatic regions are presented. Long-term median values of attenuation relative to free space for more than 750 radio paths are plotted as a function of distance. Also, a set of standard curves of basic transmission loss and attenuation below free space for earth space communications; information on unusual paths, including formulas for computing line-of-sight transmission loss with ground reflections; tropospheric propagation theory with particular attention to the mechanisms of forward scatter from atmospheric turbulence; and phase interference fading as a method for computing the probability of obtaining adequate service in the presence of noise are included. Further, antenna beam orientation, polarization, and multipath coupling loss are discussed. E.E.B.

N65-27141 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROPAGATION OF RADIO WAVES IN A MOVING SPACE PLASMA
M. A. Gintsburg *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 275–279 refs (See N65-27125 16-13)

The space plasma at the earth is in a state of constant motion. Formulations are presented to compute the electrical permeability and the refractive index for the moving plasma. There are regions in the plasma in the vicinity of the earth with current. In accordance with the formulas presented, the phase velocity and polarization of the radio waves in such a plasma with current is different from the case of a plasma without current. The integrated coefficient of radio-wave reflection from a plasma layer will also be different. A linear case is discussed. Consideration is also given to nonlinear waves, in particular isolated pulses. Some effects of electrons accelerated in oblique pulses are explained. N.E.A.

N65-27153# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
THE MEASUREMENT OF AND PHASE AMPLITUDE RADIO WAVE INTERACTION AT UNIVERSITY PARK, PENNSYLVANIA FOR OCTOBER, NOVEMBER, DECEMBER, 1964
Anthony J. Ferraro and Hai Sup Lee 1 Mar. 1965 31 p refs *Its* Sci. Rept. No. 236
(Contract AF 19(628)-4014)
(AFCRL-65-183; AD-615764)

This report presents the data obtained from the measurement of phase and amplitude radio wave interaction during the period of 1 October, 1964, through 31 December 1964. The work was carried out at the Ionosphere Research Laboratory, The Pennsylvania State University (N. Lat. 40° −47′, W. Long 77° −57′), University Park, Pennsylvania, U.S.A. The present work is categorized as "Miscellaneous Measurements" in the discipline of "Ionosphere" in the IQSY program. Author

N65-27168# Boeing Co., Seattle, Wash. Aero-Space Div.
FREQUENCY SELECTIVE LIMITER USING NUCLEAR MAGNETIC RESONANCE Final Report, 23 Apr.–26 Nov., 1964
Roger W. Orth, Darrell R. Jackson, and Glenn B. Coughlan Griffiss AFB, N. Y., RADC, Apr. 1965 146 p refs
(Contract AF 30(602)-3407)
(RADC-TR-64-543; AD-615905)

The report reviews principles of operation of the device and described developments carried out under the contract. The principal accomplishments were as follows: The circuit and quantum mechanical theory of the device was extended and refined. The magnetic properties required to obtain frequency selective limiting over a band of frequencies were determined. Expressions for insertion loss and limiting threshold were derived. The amount of intermodulation and signal suppression was calculated as a function of the interference and signal power levels and the frequency separation between them. The effectiveness of the limiter in suppressing several types of interfering signals was analyzed and an experimental model of a frequency selective limiter operating at 30 mc/sec was designed, constructed and tested. The performance goals set in the contract were essentially reached with the exception of the bandwidth of the device. The experimental development indicated that great care must be taken to assure stability of the device; as a result of this laboratory work, several techniques have evolved which can reduce stability problems in future limiter designs. The program confirmed that cw interference can be suppressed without significantly affecting a desired signal which is removed in frequency by only a few cycles per second. It was verified experimentally that the extreme case of limiting, in which an interfering signal was 30 db above a desired signal, required a frequency separation of no more than 64 cps between the two signals to assure negligible intermodulation and suppression of the desired signal. Author

N65-27171# Signatron, Inc., Lexington, Mass.
RADAR SEQUENTIAL DETECTION TECHNIQUES STUDY Final Report, Dec. 1963–Dec. 1964
Julian Bussgang et al Griffiss AFB, N. Y., RADC, Apr. 1965 97 p refs
(Contract AF 30(602)-3274)
(RADC-TR-65-10; AD-615637)

This report presents the results of a study of sequential detection techniques suitable for an electronic scan radar. The search sector of the radar is considered subdivided into many beam pointing positions and the range along any beam direction into several range bins. The number of pulses allotted in each beam pointing position is varied according to the energy received in the position being examined and is also limited by the time spent in previous positions. The purpose of the time constraint is to assure that the antenna beam returns to each position within a specified frame time. The adopted rule for allotting the quota of pulses in each beam position is called the *Cyclic Queue Allotment Rule* (CQAR). If the frame contains sufficient beam positions the analysis shows appreciable energy savings over both a uniform scan and a sequential scan truncated after a fixed number of pulses. The effect of multiple range bins is also analyzed using an "absorbing barrier" model; it is established that sequential procedures can be profitably used even when a large number of parallel range and velocity bins is tested. The increase in energy savings (relative to a fixed test) over the estimates made in previous studies is caused by introducing in the analysis the range dependence of the signal-to-noise ratio. The procedure for detecting a fluctuating target is formulated and two methods are outlined for scan-to-scan and pulse-to-pulse fluctuations. The results of this study will be encouraging to those who previously found the savings of a sequential procedure insufficient to justify a change from the conventional uniform scan. Author

N65-27174# New Hampshire Univ., Durham. Dept. of Physics.
IONOSPHERIC STUDIES UTILIZING ARTIFICIAL EARTH SATELLITE RADIO SIGNALS Final Report
Robert E. Houston Feb. 1964 105 p refs
(Contract AF 19(604)-4145)
(AFCRL-64-889; AD-615585)

A completely phase-locked, automatically tracking narrowband receiving system designed specifically for use with low-power radio signals emitted by artificial earth satellites is described. Methods utilizing the Doppler-frequency shift and Faraday rotation for the study of the regular ionosphere are outlined. Also, scintillation methods and a spaced antenna configuration for the study of irregularities in the ionosphere are discussed. Author

N65-27176 Library of Congress, Washington, D. C. Aerospace Technology Div.
TRENDS IN THE DEVELOPMENT OF MODERN RADIO-ELECTRONICS
In its Foreign Sci. Bull., Jun. 1965 p 1–17 refs (See N65-27175 16-29)

A general summary of the scope of electronics applications and probable areas of future development is given. Electronics is a basic part of such diverse fields as communications, nuclear physics, and virology. The overall current trend is toward even wider applications and equipment of better quality. Prominent areas of future work include research and development of solid-state technologies, microminiaturization, high speed computers, devices with high reliability of function, and cybernetics. J.M.D.

N65-27180# Raytheon Co., Norwood, Mass.
SUBSURFACE RADIO TRANSMISSION TESTS IN CHEYENNE MOUNTAIN Interim Scientific Report No. 7
Carson K. H. Tsao Mar. 1965 37 p refs
(Contract AF 19(628)-2362)
(AFCRL-65-298; AD-615794)

Propagation experiments were conducted in the Cheyenne Mountain area to determine the feasibility of hardened radio communications between NORAD COC and nearby surface installations. An 800-foot antenna was placed in a drill hole parallel to and 700 feet below the surface of Cheyenne Mountain. Receiving and transmitting measurements were made with this buried antenna. Analyses of the experimental results indicate that the useful frequency range is from 70 Kc to 200 Kc. In this range, estimates have been made for single-channel or multichannel teletype transmission from the COC to distances of a few tens of miles. Author

N65-27204# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
THE ANALYSIS AND DISPLAY OF THE INFORMATION CONTAINED IN TIME-VARYING SIGNALS Final Report, Jan.–Dec., 1964
Vincent J. Sharkey, William E. Fletcher, and Mario C. Grignetti 9 Apr. 1965 107 p refs *Its* Rept.-1239
(Contract AF 19(604)-8382)
(AFCRL-65-300; AD-615639)

In this report, two methods of analyzing signals, using digital techniques, are described. The first involves the computation of the autocorrelation (autocovariance) function and the estimation of the power spectrum from the autocorrelation function by Fourier transformation. The second is concerned with the estimation of over-all received signal power within pre-established frequency limits. The first is applied to the analysis of the data collected during one experiment in the FIREFLY program, the second to the data collected during one mission in the ORLANDO series. Author

N65-27238 Joint Publications Research Service, Washington, D. C.
CORRELATION FUNCTIONS OF A WAVE FIELD ABOVE A ROUGH SURFACE
In its Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 133–150 refs (See N65-27225 16-34) CFSTI: $6.00

By the perturbation method the intensity and correlation functions of a scalar wave field fluctuations above a random corrugated surface (absolutely soft and absolutely rigid) have been calculated in the limiting cases of quasi-normal and grazing propagation. In most cases under consideration, it is possible to solve the inverse problem, i.e., to restore the correlation functions of the surface corrugation from the known correlation functions of field fluctuations. The connection has been obtained between the correlation radii of field fluctuations for arbitrary functions. Some of the results obtained are applied to the fluctuations of the electromagnetic field of an elementary vertical dipole situated on a perfect conducting rough surface. Author

N65-27239 Joint Publications Research Service, Washington, D. C.
THE QUANTITY OF INFORMATION TRANSMITTED BY A QUANTUM COMMUNICATIONS CHANNEL. I.
R. L. Stratonovich *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 151–166 refs (See N65-27225 16-34) CFSTI: $6.00

The author gives a definition of quantum information that generalizes Shannon's classical definition. By way of example, computations are given for the quantum coupling information for two correlated oscillators as well as two correlated wave processes (stationary random functions). In the classical limit $\hbar \to 0$ the formulas obtained reduce to well-known formulas of information theory. Author

N65-27240 Joint Publications Research Service, Washington, D. C.
THE QUANTITY OF INFORMATION TRANSMITTED BY A QUANTUM COMMUNICATIONS CHANNEL. II

R. L. Stratonovich *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 167–183 refs (See N65-27225 16-34) CFSTI: $6.00

The entropy and information are found for a quantum communications channel in which the output variables are not commutative. The important practical case of additive noise is given special consideration. The transmitting capacity of a waveguide system with thermal noise is computed on the assumption that the channel transmission factor is a small parameter. Author

N65-27241 Joint Publications Research Service, Washington, D. C.
THE RADIATION OF AN ELONGATED SPHEROIDAL IMPEDANCE ANTENNA
G. T. Markov, D. A. Duplenkov, and N. F. Osipovich *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 184–196 refs (See N65-27225 16-34) CFSTI: $6.00

The problem of the excitation of an elongated impedance spheroid by an annular slot with a uniform field distribution in the slot has been solved. The calculated directional patterns are given for two examples of spheroids at different positions of the slot along the axis of the spheroid and different surface impedances are given. Author

N65-27249 Joint Publications Research Service, Washington, D. C.
SPACE-TIME CORRELATIONS OF A FIELD ABOVE THE SURFACE OF THE SEA
I. M. Fuks *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 253–255 refs (See N65-27225 16-34) CFSTI: $6.00

Presented are expressions for determining the relationship between the space-time correlation functions of vertical component fluctuations of a field formed by a vertical dipole close to a billowing surface of the sea. S.C.W.

N65-27318# Melabs, Palo Alto, Calif.
DEVELOPMENT OF EXPERIMENTAL ELECTRONICALLY TUNED, DECADE-BANDWIDTH RECEIVER
Beryl Barber and Herbert Weil Griffiss AFB, N. Y., RADC, Mar. 1965 25 p
(Contract AF 30(602)-3298)
(RADC-TDR-64-496; AD-614971)

Work under Contract No. AF30(602)-3298 was undertaken to develop an experimental model of an electronically tunable receiver operating between 300 and 3000 mc with a sensitivity of −90 dbm and high dynamic range. The essentially solid state design basically consists of a low-pass input filter, upconverter and associated X-band sweeper, bandpass filter, tunnel-diode amplifier, downconverter, and i-f amplifier-detector. Advances in tunnel-diode amplifier technology have precluded the need for an originally planned saturation-control circuit. The receiver program is considered to be proceeding satisfactorily at the present development phase. Author

N65-27363*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SIGNAL LEVEL PERFORMANCE OF THE INTERFEROMETER RE-ENTRY TRACKER
V. R. Simas 10 May 1965 20 p refs
(NASA-TM-X-55225; X-523-65-199) CFSTI: HC $1.00/MF $0.50 CSCL 17I

The received signal levels, P_r, are derived as a function of spacecraft position relative to the Re-entry ship. Plots of P_r vs time are included for the pertinent re-entry trajectories and the maximum deviations in spacecraft attitude, i.e., 20° lift, horizontal, and 20° drag. The factors comprising the conventional far-field equation are discussed and the criteria established for the assumptions in the values of particular parameters that were used. The results show that with 14 watts being radiated from the re-entering Apollo spacecraft, and limited by either radio blackout and/or 10° elevation angles, the observation tracking periods are nominally 100 seconds. These periods drop only about 10% with the introduction of losses amounting to 10 db. With 20 db of losses the tracking periods are nominally 70 seconds. An additional 7 db margin (about 10 db must be allocated the spacecraft) and the possibility of even longer observation periods due to possible interferometer operation below 10°, the application of the Interferometer Re-entry Tracker is considered appropriate for meeting the passive acquisition requirements associated with the Apollo Re-entry Program. Author

N65-27379*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSIF: GOLDSTONE
[1965] 32 p
(Contract NAS7-100)
(NASA-CR-63631; JPL-TM-33-05) CFSTI: HC $2.00/MF $0.50 CSCL 17B

The Deep Space Instrumentation Facility (DSIF) and its role in the Deep Space Network (DSN) are detailed. The DSN supports Apollo, Lunar Orbiter, Mariner, Pioneer, Ranger, and Surveyer space exploration projects. Goldstone, the primary station of DSIF, performs tracking, data acquisition, and command functions. It also serves as a research and development center. Four separate stations are located at Goldstone: Echo, Pioneer, Venus, and Mars, each of which has its own antenna and tracking station. It is reported that the Mars station, scheduled to be operational in 1966, has one of the world's most advanced antenna systems, which is capable of reaching not only to Mars but also to the edge of our solar system. Details of the stations are given and illustrated. Other topics discussed include the sending of a command to a spacecraft, translating information from spacecraft, and communications between the DSIF stations around the world. M.W.R.

N65-27380*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSIF: TIDBINBILLA
[1965] 24 p
(Contract NAS7-100)
(NASA-CR-63632; JPL-TM-33-207) CSCL 17B

Facilities at the Tidbinbilla Space Communications Station (TSCS) of the Deep Space Instrumentation Facility (DSIF) are detailed. First tracking assignment for TSCS was for the Mariner IV Mars probe. In addition to tracking functions, Tidbinbilla will engage in data acquisition and command duties. The antenna at TSCS, which is a standard DSIF antenna using a parabolic deflector of 85 ft diameter, and its supporting structure stand 10 stories high and weigh around 600 000 lb. Other topics considered in this report are tracing a signal received from the spacecraft, sending a command to a spacecraft, translating information from the spacecraft, and interstation communications. M.W.R.

N65-27398*# Harvard Univ., Cambridge, Mass.
EXPERIMENTAL STUDIES OF THE TRAVELING-WAVE V-ANTENNA AND RELATED ANTENNAS
Keigo Iizuka Washington, NASA, Jul. 1965 47 p
(Grant NsG-579)
(NASA-CR-260) CFSTI: HC $2.00/MF $0.50 CSCL 09F

This is a report on experimental investigation of the traveling-wave V-antenna. It includes a description of the apparatus, a discussion of the effect on the radiation patterns of variations in such quantities as the loading resistance R, the apex angle Δ, the length h of the traveling-wave section and the length h_T of the standing-wave section. Tests were also made on traveling-wave V-antennas with more than one set of resistors and with more than two arms. Author

N65-27410# Royal Aircraft Establishment, Farnborough (England).
DIGITIZING AND PROCESSING OF TRAJECTORY MEASUREMENTS [DIGITALE ERFASSUNG UND BEARBEITUNG VON FLUGBAHNMESSWERTEN]
O. Weber and K. H. Hurass Mar. 1965 29 p refs Transl. into ENGLISH from Jahrbuch W.G.L.R. (W. Germany), 1963 p 436–445 refs
(RAE-LT-1102)

The work of the D.F.L. towards digitization of radar and kinetheodolite measurements of free flight experiments is described. The difficulties (greater for kinetheodolites than for radar) are displayed. Some of the statistics of tracking error and their effects on trajectory and velocity determination are discussed, for the kinetheodolite with tracking correction omitted. The digitizing equipment at D.F.L. is described. Author

N65-27474*# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
AN INVESTIGATION OF A METHOD OF DETERMINING ANTENNA PARAMETERS BY SCATTERING CROSS SECTION MEASUREMENTS
S. J. Skarote 15 May 1965 79 p refs *Its* Rept.-1691-11 (Grant NsG-448)
(NASA-CR-63471) CFSTI: HC $3.00/MF $0.75 CSCL 09F

An error analysis of a scattering method for determining input impedance, gain, and cross section of an antenna is presented. Results obtained using the scattering method in conjunction with a calibrated, programmed load with signaling provisions are compared to those obtained using standard antenna measurement techniques. An alternate method for determining antenna parameters by the scattering method which employs a simpler non-programmed load is described. Author

N65-27530# Wisconsin Univ., Madison. Dept. of Electrical Engineering.
SURFACE WAVE AND ANTENNA ENGINEERING RESEARCH STUDY Quarterly Progress Report, 1 Sep.–30 Nov. 1964
Elmer H. Scheibe 31 Dec. 1964 17 p refs
(Contract DA-36-039-AMC-02261(E))
(QPR-1; AD-465676)

Study continued on the beam waveguide and beam waveguide resonator. Equipment and beam waveguide system elements consisting of additional diagonal horns, phase correcting lenses, and beam waveguide resonators were designed and fabricated. R.N.A.

N65-27565# Advanced Technology Corp., Timonium, Md.
STEERABLE ANTENNA FOCUSING INVESTIGATION (STAFT). IMAGE FORMING ARRAY MODEL Final Report, 7 Feb. 1964–15 Mar. 1965
W. M. Waters and B. A. Sichelstiel Griffiss AFB, N. Y., RADC, May 1965 81 p refs
(Contract AF 30(602)-2930)
(RADC-TR-65-102; AD-465138)

This report summarizes the results of an experimental evaluation of microwave image forming. A 64 element X-band planar array model was used to obtain image pictures of simply-shaped flat and three-dimensional objects. The effects of element arrangement on target definition were determined, and examples of the image quality achieved for the best element arrangement are presented. The experimental results demonstrated the ability to distinguish simple target shapes using as few as 64 elements. An approach to the situation where an array could be used for image forming of satellite targets was extrapolated from the data, and a system capable of providing 1/3 μ-radian angular resolution at 93 Gc is described. A plan for a continuation of this work which is intended to supply further information relative to the development of a realistic system is outlined in the conclusions of the report. Author

N65-27601# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
TRANSMISSION LOSS PREDICTIONS FOR TROPOSPHERIC COMMUNICATION CIRCUITS, VOLUME 2
P. L. Rice, A. G. Longley, K. A. Norton, and A. P. Barsis 7 May 1965 189 p
(NBS-TN-101, Vol. 2) GPO: $1.00

Aspects of transmission loss in tropospheric communication circuits such as beam orientation, polarization, multipath coupling loss, forward scatter, phase interference fading, and service probability are discussed. Graphical methods, and formulas for computing diffraction over smooth earth and irregular terrain, which can be processed by digital computer are given; and methods for estimating diffraction over an isolated rounded obstacle are described. Empirical graphs for estimating long-term variability for several climatic regions, are included. L.S.

N65-27621# Delaware Univ., Newark. Dept. of Electrical Engineering.
QUANTUM LIMITATIONS TO ELECTROMAGNETIC SIGNAL MEASUREMENTS Final Report, Jan. 1, 1963–Dec. 31, 1964
L. Paul Bolgiano, Jr. Dec. 1964 16 p refs
(Grant AF-AFOSR-2-63)
(AD-610422)

Statistical treatment of photoelectron counts generated from a photodetector, and the quantum statistical analysis of communications are discussed. Counting statistics for photoemissions resulting from an incoherent or random signal of limited bandwidth hitting the photodetector and counting statistics for the cases when the illumination is coherent, or is a mixture of coherent and incoherent radiation, are considered. The statistics are computed by probability functions. The photodetector is then viewed as an information channel with a Poisson channel characteristic, and a model analysis is suggested to treat the question of the maximum rate of information transmission, or capacity, for the channel. The objective of the work was to develop a foundation, consistent with quantum mechanics, for statistical communication system analysis. The statistical quantum formulation of communication systems is believed to open a new approach to statistical communication theory, and can be applied to both old and new problems in statistical communication system analysis. L.S.

N65-27628# Aeronautical Research Council (Gt. Brit.).
RADIO PROPAGATION THROUGH ROCKET EXHAUST JETS. PART I: ELECTROMAGNETIC WAVE PROPAGATION IN AN IONISED MEDIUM
H. Williams London, Min. of Aviation, Feb. 1959 67 p refs
HMSO: 12s 6d
(ARC-CP-764)

The attenuation per unit path length, phase shift per unit path length and reflection coefficient at the boundary are derived theoretically for a medium containing free electrons, in terms of the electron density, electron collision frequency with heavy molecules and the applied radio frequency. Numerical results are tabulated over wide ranges of the three variables, and these results are also presented graphically. Useful approximations to the complete theory are derived and the regions in which these may be applied in practice are indicated. Author

N65-27635# Army Signal Radio Propagation Agency, Fort Monmouth, N. J. Engineering Div.
TABULATED CHANNEL SEPARATION CRITERIA FOR COLLOCATED RADIO RELAY SETS AN/TRC-24
Oct. 1964 95 p
(AD-610363)

Accepted criteria for antenna spacing, and for channel separation between collocated radio relay sets AN/TRC-24 are summarized. The data are presented in formats to aid the user in selecting and assigning channels which provide the least mutual interference, and to acquaint users of the AN/TRC-24 set with its capabilities for interoperation of its J Band with the high band of radio set AN/GRC-50. Tables are given, listing certain channels which should not be used by sets AN/TRC-24 when a collocated AN/TRC-24 is receiving on particular channels. The tables apply to the following AN/TRC-24 equipments: A through D Bands from one to three systems, A through D Bands for four or more systems, and F Band and J Band; interoperability of J Band with high band of radio set AN/GRC-50; and summary of channels and frequency ranges. The tables concerning the A through D Bands of set AN/TRC-24 were compiled in accordance with recommended frequency separations derived from a survey of current field practice. L.S.

N65-27654# Mitre Corp., Bedford, Mass.
TIME AND COORDINATE SYSTEM STUDIES
R. K. Gardner Mar. 1965 110 p refs
(Contract AF 19(628)-2390)
(TM-04059; ESD-TDR-64-627; AD-615034)

This report describes the state-of-the-art in the determination and dissemination of time and the coordinate systems for satellite tracking. The report also recommends methods for improving the capabilities of the Space Track system. Author

N65-27662# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
FURTHER STATISTICAL PROBLEMS OF TRACKING A TARGET FROM AN OBSERVATORY SATELLITE Mathematical Note No. 377
Sam C. Saunders Apr. 1965 46 p refs Revised
(DI-82-0390, Rev.)

The statistical problems of estimation and confidence for both the location and speed and heading of a target following a linear course when tracked by radar from an observatory satellite is studied. The assumptions upon which the analysis is based is specified. The joint distribution of the estimates for target position is mathematically derived, and the maximum likelihood estimate of target position is obtained together with a proof showing it is normally distributed. In addition, confidence regions for target speed and heading, and the possibilities for tracking a target in a dense environment given certain information on the distribution of target speeds and directions, are determined. L.S.

N65-27699# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
OPTIMIZATION TECHNIQUES FOR ANTENNA DESIGN Final Report, 1 Mar. 1962–31 Dec. 1964
A. Ksienski and G. O. Young 31 Dec. 1964 14 p refs
(Contract AF 19(628)-333)
(P64-128; AFCRL-65-18; AD-610839)

The evaluation of antennas as information-gathering devices and the development of techniques to permit the comparative evaluation of linear, nonlinear, and nonreciprocal systems are reported for the following: *Spatial Frequency Characteristics of Finite Aperture Antennas; Information Theoretic Evaluation and Optimization of Antenna Systems; Generalized Coherence Theory;* and *Information Theoretic Evaluation of Nonlinear Antenna Systems.* Among the results discussed was the observation that the spectral frequency bandwidth of a finite aperture antenna is theoretically unlimited. Also, it was noted that whereas current radar system design and optimization techniques employ statistical techniques and evaluation criteria extensively, this type of radar analysis generally stops at the antenna terminals. Further, the antenna should be included as part of the over-all system to be optimized. This is accomplished by extending statistical concepts from the temporal domain into the space-time domain. E.E.B.

N65-27775# RAND Corp., Santa Monica, Calif.
A RECURSIVE METHOD OF COMPUTING THE Q-FUNCTION
L. E. Brennan and I. S. Reed Jan. 1965 8 p refs
(P-2949-1; AD-610784)

A recursive procedure for rapid machine computing of the Q-function

$$Q(a,t) = \iint_{x^2+y^2>t^2} e^{-\frac{(x-a)^2+y^2}{2}} \frac{dxdy}{2\pi}$$

is described in which the average time per Q computation with an accuracy of 10^{-5} is about five milliseconds on an IBM 7040/44, using a Fortran program. The method involves replacing the zero-order Bessel function by its series expansion. A remainder term is presented which gives the error accumulating in Q after N iterations. The above form of the bivariate normal distribution often occurs in radar detection theory. J.M.D.

N65-27806# Technical Research Group, Inc., Menlo Park, Calif.
SCATTERING FROM ROTATIONALLY SYMMETRIC METALLIC BODIES Final Report
M. G. Andreasen Apr. 1964 86 p refs Prepared for Lincoln Lab., MIT
(Contract AF 19(628)-500)
(AD-610607)

This work is concerned with a theoretical evaluation of electromagnetic scattering from metallic bodies of revolution for an arbitrary longitudinal cross-section. The problem is solved by an exact integral equation method. The validity of the computer program developed has been verified by comparing the results for scattering by a sphere with exact analytical results which are available for this special case. Numerical results are presented for the current distribution induced on a number of test bodies such as a rod, a cone sphere and a disc. Author

N65-27821*# National Aeronautics and Space Administration, Washington, D. C.
SPACE COMMUNICATIONS: THEORY AND APPLICATIONS. VOLUME I: MODULATION AND CHANNELS A Bibliography

Richard F. Filipowsky and Louise C. Bickford, comp. Jun. 1965 486 p
(NASA-SP- 7022(01), Vol. I) GPO: HC $2.50/MF $2.50 CSCL 17B

An annotated bilbliography on modulation and channels with regard to theory and applications to space communications is presented. References are from various reports, journal articles, and books published during the period 1958–1963. Subject contents include: fundamentals and communications theory; analog, digital, sampling, pulse code, wideband, and multiplex modulation methods; distortion characteristics of communications channels; noise and disturbances in transmission channels; and comparisons of modulation methods. L.S.

N65-27826*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-33, VOLUME III FOR THE PERIOD MARCH 1, 1965 TO APRIL 30, 1965. THE DEEP SPACE NETWORK
31 May 1965 112 p refs
(Contract NAS7-100)
(NASA-CR-63744) CFSTI: HC $4.00/MF $0.75 CSCL 17B

The Deep Space Network is discussed in terms of operations and research and development. Tracking stations engineering and operations and the performance of the Deep Space Instrumentation Facility (DSIF) monitoring program during Rangers VIII and IX are among the topics considered. A section on communications engineering deals with developments in S-band equipment and implementation for the DSIF, Mariner IV occultation measurements and Venus Station support, coherent frequency translation, and the range receiver and Doppler multiplier. The final section of the report, on communications research and development, includes information about ground antennas, refrigeration for masers, Venus Station operations, transmitters, lunar-planetary radar, and communication and information systems. M.W.R.

N65-27869# University of Southern Calif., Los Angeles. Electronics Sciences Lab.
STOP-SCAN EDGE DETECTION SYSTEMS OF TELEVISION BANDWIDTH REDUCTION Interim Technical Report
W. K. Pratt Jun. 1965 185 p refs
(Contract AF 04(695)-537)
(USCEE-131; SSD-TR-65-44; AD-465268)

A family of systems is developed to code television pictures such that the bandwidth, or time, required for transmission is reduced significantly compared to transmission by conventional pulse code modulation. The systems have application for spacecraft television communication where the reduced bandwidth enables a reduction in transmitted power. Data from optical detection and tracking sensors may be processed at a significantly increased rate with the systems. Also, for a fixed communications bandwidth, the television bandwidth reduction systems permit an increase in the number of television channels that can be relayed by an earth orbiting satellite or microwave relay station. In this report the psychophysical properties of image viewing related to television systems are investigated to determine the relationship between television design parameters and communications bandwidth. Information theoretic bounds of bandwidth reduction and the optimum selection of system parameters are established. Statistical image measurements are performed to determine the probability of occurrence of edges. The implementation of an operational prototype of the basic stop-scan edge detection system is described. Viewing tests are performed to verify the quality of pictures processed by the basic system. Author

N65-27948*# Michigan Univ., Ann Arbor.
INVESTIGATION OF NONLINEAR INTERACTION PHENOMENA IN THE IONOSPHERE
H. C. Hsieh, R. J. Lomax, and J. E. Rowe Washington, NASA, Jul. 1965 85 p refs
(Grant NsG-696)
(NASA-CR-258) CFSTI: HC $3.00/MF $0.75 CSCL 04A

The ionospheric phenomena such as thermal radiation noise, the propagation of naturally occurring radio noise through the ionosphere, and the generation of very low frequency emissions are under study. Various traveling-wave interaction mechanisms are also being studied to determine their applicability in explaining these various phenomena. Many of the phenomena of interest involve the interaction of drifting streams of charged particles and electromagnetic waves, including the excitation of electrostatic plasma oscillations and cyclotron wave interactions. Two methods that were used are a Lagrangian particle analysis, and the nonlinear collisionless Boltzmann equation which is solved by a moment expansion method; Boltzmann's equation describes the evolution of the electron density function, and a general Lagrangian nonlinear analysis is outlined and applied to the beam–plasma system. R.W.H.

N65-27949*# Data Systems Div., Litton Industries, Canoga Park, Calif.
SCAN CONVERTER FEASIBILITY STUDY Final Report
8 Feb. 1965 18 p
(Contract NAS9-3512)
(NASA-CR-65050; DS-64-0175) CFSTI: HC $1.00/MF $0.50 CSCL 17B

A study to investigate the feasibility of using an electrostatic image recorder to convert Apollo television images to standard commercial television formats is reported. The study was based upon results obtained on an Air Force program which involved the use of Litton wire-array cathode-ray tube. The three main areas of investigation were: resolution, frame-to-frame background shading, and the quality of gray-scale reproduction. Results of the study, including a demonstration of the modified laboratory model, were highly successful in establishing the feasibility of the electrostatic recording technique. Acceptable qualities of resolution, background shading, and gray-scale reproduction were obtained. However, despite the improved recording characteristics demonstration of the Litton wire-array cathode-ray tube, degradation of picture quality was apparent during the demonstration. An investigation of the picture quality was performed and results are presented. N.E.A.

N65-27966# Michigan Univ., Ann Arbor. Radiation Lab.
DIFFRACTION AND SCATTERING BY REGULAR BODIES Final Report, Feb. 1960–Jan. 1965
R. E. Kleinman Feb. 1965 20 p refs *Its* Rept.-3648-F
(Contract AF 19(604)-6655)
(AFCRL-65-199; AD-614046)

Three comprehensive reports on scattering by simple shapes, covering the sphere, cone, and prolate spheroid, are summarized, and the various equations and analyses used are discussed. A closed form expression for the solution of the problem of diffraction of a line source by a soft strip was given. A general class of solution of the two-dimensional Helmholtz equation which satisfied simple boundary conditions, were used to construct a (double) integral equation for the Green's function of the first kind for a line segment. Extensions of these results are also discussed. For the scaler problem of diffraction of a plane wave incident along the axis of symmetry of a spheroid, prolate or oblate, the low frequency expansion of the scattered far field was obtained, by expanding the exact series of spheroidal wave functions. Results were obtained for Dirichlet and Neumann boundary conditions.

Other approaches to the solutions of scattering problems are examined. Nonlinear modeling of three different physical processes, described by three basic partial differential equations, was also considered. For the Helmholtz equation (elliptic) and the diffusion equation (parabolic), it was found that the allowable modeling functions must satisfy a particular nonlinear ordinary differential equation. R.W.H.

N65-27967# RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
ELECTROMAGNETIC WAVE PROPAGATION IN ANISOTROPIC PLASMAS ALONG THE DIRECTION OF A STATIC MAGNETIC FIELD Scientific Report No. 1
M. P. Bachynski and B. W. Gibbs Dec. 1964 164 p refs
(Contract AF 19(628)-4071)
(AFCRL-65-84; AD-614442)

A detailed quantitative experimental and theoretical investigation of the propagation of electromagnetic waves in an anisotropic plasma along the direction of the applied static magnetic field was conducted. Experimental measurements of electron density and attenuation using circularly polarized waves showed good agreement with theory and with each other over all ranges of parameters. A theory of propagation of linearly polarized waves in anisotropic plasma was derived and gave good agreement with measurements of both the phase and intensity of the components of electric field parallel and cross-polarized to the incident field. Also, investigations of the collisional effects on the electromagnetic wave propagation in the region of the electron cyclotron frequency showed a reversal in phase of the wave passing through the plasma as the electron density was increased. This was observed only for the right-hand circularly polarized wave at frequencies very near but just above the electron cyclotron frequency. Collisional effects based on cold plasma theory can account for this behavior. E.E.B.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-26752 Contrôle Technique Suisse des Montres, Neuchâtel.
USE OF AN ELECTRONIC COMPUTER AT THE CONTROLE TECHNIQUE SUISSE DES MONTRES (C.T.M.) [L'ORDINATEUR ELECTRONIQUE AU SERVICE DU C.T.M.]
W. Wenker *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1233–1241 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The computer service of C.T.M. uses 2 types of equipment: (1) a digital computer (IBM 1620) with input by punched tape and punched cards; (2) conventional equipment: tabulator, sorter and alphanumerical card-puncher. The measurements made on watches at the 14 different branches of C.T.M. in Switzerland, are sent daily to the computer service. The measurements of all watches are punched on a tape, while the characteristics of the lot are punched on a card. This information is then treated by the computer; the output is on punched cards which are used directly for the printing of the testing certificates and the statistics. New measurement devices at present under development will give the results directly on punched tape so that the manual punching will be obviated. Author

N65-26929# General Electric Co., Oklahoma City, Okla. Military Communications Dept.
MATRIX CONTROLLED DISPLAY DEVICE, PHASE II Interim Engineering Report, 11 Jan.–5 Apr. 1965
26 Apr. 1965 34 p
(Contract NObsr-89334)
(AD-615100)

The progress in a program to develop a feasibility model of a bright, large screen matrix type display using in-air thermoplastic recording and TIRP (Total Internal Reflection Prism) projection techniques is reported. A brief summary of the Phase I program is given prior to discussing the current Phase II effort. The test setup to provide a 25 X 25 elemental portion of the large screen display by optical readout of deformations on a thermoplastic medium is described. Control of the in-air recording process by an X-Y matrix to provide individual storage of information is discussed. Techniques to be employed for fabricating a 25 line matrix with electrodes at 500 line pairs per inch are listed. The results are given for the several fabrication processes which have either been completed or have commenced. These include the preparation of artwork and a photographic mask, exposure of a photosensitive resist to form the reverse image of the matrix electrodes prior to etching, and the coating of glass plates to be used for matrix substrates with a transparent conductive film of indium oxide. Etching to form the matrix and the subsequent formation of low resistance contacts to the matrix electrodes by electroless copper plating have yet to be completed. Initial experiments with electroless copper plating were performed and are described. The fabrication of a 2000 line matrix, which is to be initiated during this contract, is discussed. Author

N65-26938# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
A COMPUTER PROGRAM TO CALCULATE THE DYNAMIC ELASTIC–PLASTIC RESPONSES OF SEQUENTIALLY-LOADED FREE SINGLE-LAYER CIRCULAR RINGS
William A. Loden Oct. 1964 88 p refs
(Contracts AF 33(657)-8427; DA-19-020-AMC-00293(A))
(ASRL-TR-122-2; AD-461887)

A description of the FORTRAN II computer program for a general numerical method for analyzing large two-dimensional elastic-plastic dynamic deformations of free circular rings subjected to an initial impulse loading followed by a prescribed distributed transient pressure loading is given. Program assumptions, arrangement, data input procedure and instructions, and program output are described in detail. To assist the user on checking the adaptation of these programs to his computer facility, the inputs and results are given for a particular sequentially-loaded ring with elastic, strain-hardening, strain-rate sensitive material behavior (EL-SH-SR) and for dimensional nondimensional versions of another sequentially-loaded ring of a material with elastic, perfectly-plastic material behavior (EL-PP). Author

N65-26972# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Groupe de Recherches sur la Fusion Controlée.
SIMPLE ANALOG COMPUTER FOR SOLVING THE ABEL INTEGRAL EQUATION [UN CALCULATEUR ANALOGIQUE SIMPLE POUR RESOUDRE L'EQUATION INTEGRALE D'ABEL]
Lothar Becker and Hans-Werner Drawin Brussels, EURATOM 1965 24 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-007-62-1 FUAF)
(CEA-R-2448; EUR-1806.f) Available from Belg. Am. Bank and Trust Co., New York Account No. 22.186: 40 Belg. Fr.

A special, very simple analog computer is described which permits a rapid and direct calculation of the radial distribution of the emission coefficient of an axial symmetrical discharge column from "side-on" observed light intensities. The different values of the emission coefficient can be obtained for arbitrarily following radial distances without beginning obligatory at the edge of the column or at the wall of the discharge tube. The computer is very easy to handle. The precision obtained with apparatus is shown using some practical examples. Author

N65-26979# Joint Publications Research Service, Washington, D. C.

SOME PROBLEMS OF INPUT–OUTPUT OF DATA IN A KEYBOARD DESK COMPUTER

M. K. Chirkov, I. Ya. Bereznaya, and A. P. Shartukov 30 Jun. 1965 13 p refs Transl. into ENGLISH from Vychislitel'naya Tekhn. i Vopr. Programmirovaniya (Leningrad), no. 1, 1962 p 48–57

(JPRS-30892; TT-65-31391) CFSTI: $1.00

In discussion of serial action desk keyboard computers with ferrite-diode registers, advantages and disadvantages of various input–output devices are described. The discussion covers arrangements for visual indication of output numbers, full- and ten-key keyboards, and means of code conversion. Block diagrams are presented for the two keyboard concepts, and circuits are shown for the input unit, bit counter, and for a ferrite-diode device for conversion of binary-decimal data to a decimal code. J.M.D.

N65-26993# Michigan Univ., Ann Arbor. Dept. of Communication Sciences.

EQUIVALENCES BETWEEN PROBABILISTIC AND DETERMINISTIC SEQUENTIAL MACHINES

C. V. Page May 1965 72 p refs

(Contract Nonr-1224(21); Grants DA-ARO(D)-31-124-G558; NSF GP-2539; NIH GM-12236-01)

(AROD-4049-13; Rept.-03105-37-T; AD-463885)

A deterministic machine whose output possesses certain statistical properties of the output of a given probabilistic machine is constructed. Statistical parameters such as the expected value of output and the variance and higher moments of the output random variable are considered. Congruence relations are used to construct quotient machines which are deterministic. States of the quotient machines correspond to congruence classes, the members of which have the same expectation and first N-1 central moments. By connecting a random device to each state which has the same statistical properties of the congruence class represented by the state, an equivalent deterministic machine with random output is obtained. A suitable condition for indistinguishability of two probabilistic sequential machines is considered. A finite complete set of invariants for the various equivalence relations used in the reduction of probabilistic machines to deterministic machines and for machine equivalence are included. A generalization of the Moore bound for indistinguishability of deterministic machines with binary outputs to multioutput probabilistic machines is presented. R.N.A.

N65-27061*# Westinghouse Electric Corp., Newbury Park, Calif. Astroelectronics Dept.

MOLECULAR POWER SUPPLY SYNCHRONIZER Second Quarterly Report, Aug.–31 Oct. 1962

(1962) 23 p Prepared for JPL

(Contracts NAS7-100; JPL-950237)

(NASA-CR-63555) CFSTI: HC $1.00; MF $0.50 CSCL 09B

Progress is reported on the development of a molecular power supply synchronizer. A test run was conducted to determine the sensitivity of the logic system to rise time of the input signal. A sine wave was used to drive the dc coupled logic even. The sine wave input was equal to that of a square wave input. The size and geometry of the double NAND gates were changed allowing overall unit to be reduced to a 0.275 by 0.275 chip. Feasibility tests using the substrate to carry the ground current were completed. A group of P-type wafers with resistivity of 0.001 ohm centimeter and thickness of 4.5 mils was used to grow epitaxially a 0.2 ohm centimeter P film of 22 microns. Point contact to back plane resistances of less than one ohm were obtained indicating that the impedance would be low enough to permit the required currents to flow. A nonlinear load switch for the molecular power supply synchronizer was fabricated. The packaging design was changed to mount the package in an inverted position with the leads emerging from the top and fanned out to make contact with a printed circuit board. A new microstroke forms the logic. R.N.A.

N65-27069# Los Alamos Scientific Lab., N. Mex.

A FORTRAN VERSION OF NORDSIECK'S SCHEME FOR THE NUMERICAL INTEGRATION OF DIFFERENTIAL EQUATIONS

H. R. Lewis, Jr. and E. J. Stovall, Jr. 22 Jun. 1965 38 p refs (Contract W-7405-ENG.36)

(LA-3292) CFSTI: $2.00

Modifications of Nordsieck's scheme for numerically integrating differential equations are described which permit satisfactory operation in floating-point arithmetic. The major modification, recommended for both fixed-point and floating-point operation, is a reformulation of the test for numerical stability. Also discussed, in relation to the present floating-point scheme, are Nordsieck's use of guard digits and novel rounding techniques. A computer subroutine for the modified scheme is presented in the FORTRAN-II and FORTRAN-IV languages. Author

N65-27222# European Atomic Energy Community, Brussels (Belgium).

PROGRAMMATION RELATING TO CALCOMP [PROGRAMMATION RELATIVE AU CALCOMP]

P. Moinil and J. Pire 1965 150 p In FRENCH; ENGLISH summary

(EUR-2280.f) Available from Belg. Am. Bank and Trust Co., New York Account No. 22.186: 195 Belg. Fr.

The set of subroutines described in this manual gives facility for Data Plotter Calcomp (564 or 506) utilization in scientific programs written in Fortran II or Fap, and to be executed on IBM 7090–7094. These subroutines prepare an output tape which is transmitted to the Data Plotter by an IBM 1401. Author

N65-27316# Electronic Systems Div., Bedford, Mass. Directorate of Computers

ADVANCED PROGRAMMING DEVELOPMENTS: A SURVEY

Feb. 1965 108 p refs Prepared jointly with Computer Associates, Inc.

(ESD-TDR-65-171; AD-614704)

This document constitutes a representative survey of twenty computer software systems which have been developed within the last decade. The surveyed systems have been grouped into six major categories: (1) general purpose programming and executive systems; (2) functional systems; (3) man-machine interface systems; (4) special purpose programming systems; (5) time-sharing systems; (6) generalized data management systems.

Each system discussed within these categories exhibits a particular feature or set of features which constitutes a distinct contribution to the effort to produce more general, more flexible and less job dependent systems which can be conveniently operated by a user. The survey notes that to date efforts to develop these features into integrated computer systems and sub-systems exist only on a small scale and in only a small number of laboratories scattered across the country. In view of the many potential applications of such integrated, generalized computer systems, especially in military environments, the survey concludes that the time is ripe for a technical program designed to demonstrate the feasibility of generalized computer systems and sub-systems in the solving of traditional data processing problems. Author

N65-27328# Laboratory for Electronics, Inc., Boston, Mass. Solid State Electronics Lab.
STUDY AND INVESTIGATION OF TECHNIQUE FOR CONSTRUCTING MEDIUM-SPEED RANDOM ACCESS MASS MEMORY Final Report, 1 May–1 Nov. 1964
Thomas L. McCormack et al Griffiss AFB, N. Y., RADC, Mar. 1965 291 p refs
(Contract AF 30(602)-3422)
(RADC-TR-64-538; AD-614831)

This document reports on the results of a six-month program aimed at showing the feasibility of constructing medium speed random access mass memories using batch fabrication techniques. The batch fabrication technique makes use of toroids etched out of sheet permalloy to batch fabricate the memory elements, and all drive and sense wiring is provided by a combination of precision etching and plating techniques. The resultant memory is inherently low power. System designs have been developed which use, for the most part, integrated circuitry. The resulting mass memory system of, say, 10^8 bits capacity is small (2 to 5 cubic feet), light (300 pounds), economical (less than one cent/bit), low power (less than 200 watts), medium speed (read-write cycle 25 to 35 μseconds), nonvolatile (magnetic), and also permits non-destructive readout. The major accomplishments of the project period have been the successful fabrication of planes having 16 × 16 bits on 25 mil centers with reasonable and steadily improving yield, initial success at fabricating 64 × 64 bit planes on 25 mil centers using mechanical pin registration, study of materials applicable to the memory, establishment of an economical manufacturing process, and experimental and theoretical investigations of S/N as it relates to such large scale memories. Author

N65-27464# Dow Chemical Co., Denver, Colo. Rocky Flats Div.
A COMPUTER PROGRAM TO CONVERT GAS ANALYSIS DATA FROM UNITS OF VOLUME PERCENT TO MOLAR QUANTITIES
C. A. Larson 18 Jun. 1965 14 p
(Contract AT(29-1)-1106)
(RFP-564) CFSTI: $1.00

A computer program has been prepared, for use on the ASI-210 digital computer, which will convert gas analysis data from units of volume percent to molar quantities. Author

N65-27518# North Carolina Univ., Chapel Hill. Psychometric Lab.
ESTIMATION OF CONTINUOUS SUBJECTIVE PROBABILITY DISTRIBUTIONS IN A SEQUENTIAL DECISION TASK
Amnon Rapoport Bedford, Mass., AFSC, Electron. Systems Div., Oct. 1964 23 p refs
(Contract AF 19(628)-1610)
(ESD-TDR-64-607; AD-614684)

A range betting method (RBM) for measuring continuous subjective probability distributions is presented. Predictions derived from the method are tested in a computer-controlled sequential decision making task. In particular, twenty-two undergraduate students participated individually in the task. The subjects were asked occasionally to place a wager upon the range of an unknown value of P, $0 \leq P \leq 1$, generated by an LPG-30 computer. In addition, the subjects predicted the exact value of P by typing a number on a Flexowriter, and then estimated the value of P after obtaining information about its value. The information was given in the form of n values ($1 \leq n \leq 20$) of 0's or 1's generated by a binomial distribution with mean P and printed on the Flexowriter in front of the subject. Predicted decisions were derived both from the RBM method and from a relatively simple confidence limits' model. The subjects' estimates of the range boundaries were compared to the predicted values from both models. In both comparisons the results indicated a regression effect and a block-to-block tracking behavior. Attempts to compare two independent measures of the same subjective probability distribution were unsuccessful. Author

N65-27519# North Carolina Univ., Chapel Hill. Psychometric Lab.
RESEARCH AND DEVELOPMENT FOR QUANTIFYING PROCESSING OF PROBABILISTIC (UNCERTAIN) DATA Final Report, 1962–1964
William H. Wynn Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1964 25 p refs
(Contract AF 19(628)-1610)
(ESD-TDR-65-162; AD-614595)

Research in decision making with emphasis on the quantification of processing of probabilistic data is described. An extension of the Bayesian model was formulated to account for the trial-to-trial changes in the predictions and estimates of individual subjects. This model had two free parameters concerning individual differences; one for weight given to past experience, and another for the weight given to the most recent observations. When values of these parameters providing the best fit for average predictions and estimates of the subjects were used, the fit was remarkably good. An optimal Bayes strategy model was also derived to investigate the extent to which human information seeking may be accounted for in terms of a rational theory of behavior. The important variable in determining a stopping rule was found to be the expected probability of being correct. A no-information theorem was presented which shows that under some circumstances when a success or failure on a given trial are equally probable, the probability of being correct after making the observation is identical to the probability of being correct before the observation was taken. Abstracts of related studies are also included. R.W.H.

N65-27551# System Development Corp., Santa Monica, Calif.
PRESERVATION OF UNAMBIGUITY AND INHERENT AMBIGUITY IN CONTEXT FREE LANGUAGES Scientific Report No. 2
Seymore Ginsburg and Joseph Ullian (Calif. Univ., Santa Barbara) 12 Jan. 1965 13 p refs
(Contract AF 19(628)-3418)
(TM-738/011/00; AFCRL-65-178; AD-614073)

Various elementary operations are studied to find whether they preserve unambiguity and inherent ambiguity of languages ("language" means "context free language"). The following results are established: (1) If L is an unambiguous language and S is a generalized sequential machine then (a) S(L) is an unambiguous language if S is one-to-one on L, and (b) $S^{-1}(L)$ is an unambiguous language. (2) Inherent ambiguity is preserved by

every generalized sequential machine which is one-to-one on the set of all words. (3) The product (either left or right) of a language and a word preserves both unambiguity and inherent ambiguity. (4) Neither unambiguity nor inherent ambiguity is preserved by any of the following language-preserving operations: (a) one-state complete sequential machine; (b) product by a two-element set; (c) Init(L) = {u ≠ ε/uv in L for some v}; (d) Subw(L) = { w ≠ ε/uwv in L for some u, v }. Author

N65-27558# Air Force Systems Command, Wright-Patterson Technology Div.

AN ELECTROMECHANICAL MULTIPLYING INTEGRATING DEVICE

N. M. Rudnyy and L. A. Vereshchagin 9 Apr. 1965 7 p Transl. into ENGLISH from Russian Patent no. 154096 (Appl. no. 775075/26-24, 21 Apr. 1962) 3 p
(FTD-TT-64-1083/1+2; AD-614763)

An electromechanical multiplying and integrating device which is distinguished by the fact that for the purpose of automation of the process of computing the integral function it is designed in the form of an immovable half ring on which there is fastened an induction output coil and two movable elements, one of which represents a toothed half disk rigidly connected with a permanent magnet, and the other is designed in the form of a revolving clamp with terminals which serve for closing an overall magnetic flux. Author

N65-27592# Sperry Rand Corp., St. Paul, Minn. UNIVAC Div.

DEVELOPMENT OF AN ELECTRONIC DATA PROCESSING MODULE FOR MOBILE WING RECONNAISSANCE TECHNICAL SQUADRON Final Report, Jun. 1963–Oct. 1964

C. A. Christensen Griffiss AFB, N. Y., RADC, Mar. 1965 45 p (Contract AF 30(602)-3171)
(RADC-TR-64-520; AD-614239)

The Electronic Data Processing Module (EDPM) has been developed to provide computer assistance for the analysis and interpretation of reconnaissance data in the tactical field environment. The EDPM can rapidly process large volumes of data which could not be handled with sufficient speed and accuracy by human operators. The EDPM forms a major functional module of the Mobile wing Recce Tech (MWRT) which is a field deployable reconnaissance reduction facility. The MWRT, in turn, is a major subsystem of the Limited Warfare Intelligence Reduction Complex being developed by the Rome Air Development Center (AFSC) under OSR 406. Author

N65-27599# Joint Publications Research Service, Washington, D. C.

PROBLEMS IN OPTIMAL CONTROL, CODING, AND PROGRAMMING OF COMPUTERS

P. N. Psenichnyy 3 Jul. 1965 63 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 5, no. 2, Mar–Apr. 1965 p 236–251, 311–325, 369–372
(JPRS-30939; TT-65-31438) CFSTI: $3.00

Six articles related to programing are included and deal with the following subjects: 1) *One Algorithm for Solution of a Nonlinear Optimal Control Problem*; 2) *Determination of Optimally Responsive Controls for Linear Multidimensional Systems by Means of Methods from Functional Analysis*; 3) *Codes Capable of Correcting Arithmetic Errors*; 4) *The Al'fa Compiler*, which uses an Algol language; 5) *Expansion of the Logical Possibilities of Algol-60*; and 6) *A Course in Programing*, which is a review of a book of the same title. M.W.R.

N65-27618*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DIGITAL COMPUTER SIMULATION OF THE INFRARED INTERFEROMETER SPECTROMETER (IRIS) AND INTERFEROGRAM ANALYSIS

L. H. Byrne Jan. 1965 72 p refs
(NASA-TM-X-55219; X-650-65-24) CFSTI: HC $3.00/MF $0.75 CSCL 20F

A digital computer program for simulating the output of the infrared interferometer spectrometer (IRIS), and a program for the analysis of the resultant interferogram are used for determining and verifying instrument design parameters, and for providing the basis for operational computer programs needed to process and analyze data from the actual instrument. The two programs form a closed-loop synthesis/analysis model for testing the effects of instrumentation and design parameters on both the interferogram and the transformed spectral profile. Results indicate that a sampling rate for IRIS of about four times the highest frequency present is desirable. The effect on the transformed spectral profile due to digitizing is about the same as the effect due to the mean expected signal-to-noise ratio at the detector. The effect due to finiteness of the optical solid angle is less than that caused by digitization or noise at the detector. Additional distortions of data from an actual interferometer may occur due to secondary effects not included in the simulation. L.S.

N65-27668# Army Engineer Research and Development Labs., Fort Belvoir, Va. Scientific and Technical Information Branch

ADJUSTMENT OF POLYGON NETWORKS ON AN ELECTRONIC COMPUTER

I. I. Kupchinov and V. P. Vilenskiy [1964] 9 p Transl. into ENGLISH from Geodez. i Karograf. (Moscow), 6 1964 p 17–21 (T-1759; AD-610472)

A computer program was developed for separately adjusting polygon networks by a node method. The program was worked out for networks with up to 20 soft nodes and not more than 40 traverses, with the number of traverse points not exceeding 20. Such networks are typical in actual polygon and theodolite surveys. A breakdown of the cell usages is given, and the polygon program is represented graphically in accordance with stated rules before adjustment. The machine program comprises computation of the preliminary hour angles of node lines, of the adjusted hour angles of node directions, of preliminary abscissa and adjusted abscissa values of soft node points, of preliminary and adjusted values of ordinates of soft node points; and formulation and solution of normal equations for hour angle and abscissa equations. Checks on the computation of the remainder free terms are included, and the last step in the program evaluates the accuracy of the measurements. L.S.

N65-27742# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A SMALL SCALE CONTINUOUS ACTION PNEUMATIC COMPUTER AND DELAY BLOCK

N. D. Lanin 12 Aug. 1964 15 p Transl. into ENGLISH from Vopr. Pnevmo- i Gioroavtomatiki, Akad. Nauk (Moscow), 1960 p 138–147
(FTD-TT-64-523/1+2; AD-605509)

A small scale continuous action pneumatic computer intended for investigating automatic control systems is described. In addition, a description of a differentiating link and delay block is given. The mathematical structural arrangement of a pneumatic computer capable of solving an ordinary linear differential equation of n-order with constant coefficients is outlined. The complete machine consists of a summator and six in-series connected integrating blocks, each one of which

contains a pneumo choke, pneumo capacitance, detecting element, and summating block (except for the first block which does not contain a summator). A complete scheme of the computer, and separate schemes of the summation block and integration block are diagramed. The complete unit is also pictured in a photograph. The computer passed checkout tests. Another schematic diagram is included, showing a differentiating link. Equations are given for the aperiodic link for straight channel, feedback, and the summator. Also described are three methods for constructing pneumatic delay blocks. L.S.

N65-27764# Aberdeen Proving Ground, Md. Computing Lab.
SYMBOLIC DERIVATIVES WITHOUT LIST PROCESSING, SUBROUTINES, OR RECURSION
Peter J. Smith Feb. 1965 19 p refs
(BRL-MR-1630; AD-465252)

A routine has been developed which computes and prints out the symbolic derivative of an absolutely continuous elementary function of one or several variables. No use is made of list-processing languages so that the routine is fast. The chain rule is applied and the result is edited to produce results as elegant and efficient as those obtained by hand computation. A subset may be imbedded in a formula translator to introduce a differentiation operator into an "algebraic" programing language. Author

N65-27769*# General Precision, Inc., Palo Alto, Calif. Link Group.
ANALOG–DIGITAL DATA ARCHIVE STUDY Final Report, 30 Jun.–10 Oct. 1964
[1964] 107 p refs
(Contract NAS5-9710)
(NASA-CR-63696; WDR-96-3) CFSTI: HC $4.00/MF $0.75 CSCL 05B

To determine the most suitable method for recording, storing, and retrieving telemetry data, investigations were made into the problem areas of the existing magnetic tape system at the Goddard Space Flight Center. Emphasis was placed on the preservation of data over a long period of time and the reduction of storage space. It was concluded that photographic film on a polyester base was the optimum archiving medium, and mathematical analysis pointed to the use of reel film for the specific task under consideration. A thorough quantitative analysis led to a proposed design of a film recorder and complete storage system, details of which, are included. Appended to the report are reprints of two articles, entitled *Accidental Printing in Magnetic Recoding* and *High-Stability Magnetic Tape Data-Processing Systems*. *M.W.R.*

N65-27784# California Univ., Livermore. Lawrence Radiation Lab.
REDUCTION OF PHOTOGRAPHIC SURFACE-MOTION DATA BY DIGITAL COMPUTER
Robert W. Terhune, Roger L. Fulton, and J. B. Knox 12 May 1965 38 p refs
(Contract W-7405-ENG-48)
(UCRL-14155) CFSTI: $2.00

This paper presents a method of rapidly obtaining detailed surface-motion information from a high-explosive or nuclear cratering explosion. The information is obtained from reading and analyzing, by means of digital computer, the film from high-speed photography of surface motion. The experimental requirements, description of computer programs, and analysis procedures are given. Samples of surface motion displacement, velocity, and accelerations acquired by this method from a specific event are presented and verified by standard techniques. Author

N65-27921# Weapons Research Establishment (Australia).
SOME RESULTS OF AN AUTOMATIC MINIMIZATION TECHNIQUE FOR MODEL CHECKING USING AN IBM 7090 COMPUTER
H. G. Newbigin and J. S. Allison Jan. 1965 12 p refs
(WRE-SAD-142)

In the evaluation of complex systems using mathematical models, it is necessary, among other things, to determine (a) whether or not the model is functionally correct, and (b) whether particular units tested are representative members of production units. Both problems require a deduction from experimental results of the probable values of various parameters of the particular unit concerned in the experiment. These values may be obtained by adjusting parameters in the model until satisfactory agreement is obtained between the output of the model and the measured output of the physical system, when both are forced by nominally the same input functions. Using non-iterative analogue computers, this parameter adjustment usually involves the use of an experienced scientist, who, from an examination of the characteristics of the differences between the outputs of the model and the unit in question, assesses which parameter or parameters requires adjustment. This report presents some results of the use of a minimization technique on IBM7090 which automatically adjusts the model parameters in order to minimise the mean squared error. The standard of agreement obtained is significantly better than has been obtained by earlier methods, and the technique offers major savings in the use of staff and equipment. The improved agreement makes it easier to determine whether the model is functionally correct. Author

N65-27924# Argonne National Lab., Ill. Applied Mathematics Div.
COGENT PROGRAMING MANUAL
John C. Reynolds Mar. 1965 118 p refs
(Contract W-31-109-ENG-38)
(ANL-7022) CFSTI: $4.00

The basic concepts and major features of the COGENT (compiler and generalized translator) programing system are presented. The COGENT is a compiler whose input language is designed for the description of symbolic or linguistic manipulation algorithms. The system is intended for use as a compiler but is also applicable to problem areas such as algebraic manipulation, mechanical theorem proving, and heuristic programing. A complete specification of the COGENT language is given and includes list structures, basic symbols of the language, overall structure of a COGENT program, character definitions, syntax analyzer and descriptions, constants, generator description, declaration and input variable sequences, expressions and assignment statements, statement labels, control statements, and control flow. Primitive generators and internal variables of the COGENT system are described. A complete program for symbolic differentiation is given as an example of COGENT programing. R.N.A.

N65-27936# System Development Corp., Santa Monica, Calif.
DIGITAL SIMULATION AND SYSTEM THEORY
Michael R. Lackner 6 Apr. 1964 45 p refs Submitted for Publication
(SP-1612)

This study states that human organizational systems, as object systems of digital simulation, require means of identifying their components, characterizing each one, articulating their interrelationships, stating the whole and drawing conclusion. Affirms that nothing short of general system theoretical development will do. Reports that existing simulation schemes do not explicate the theory of the models they are used to build, although they do organize a set of solutions to the practical

problems of implementing a very complicated computer program. Suggests a scheme for modeling processes and producing a well-organized simulation model. Introduces a calculus of change as an approach to the general problem of developing system theory. Author

N65-27954*# Arizona Univ., Tucson. Coll. of Engineering.
HYBRID ANALOG–DIGITAL TECHNIQUES AND RANDOM-PROCESS STUDIES, 1964–1965
Granino A. Korn et al [1965] 32 p refs *Its* EES Ser. No. 5
(Grants NsG-648; AF-AFOSR-89-63)
(NASA-CR-63769) CFSTI: HC $2.00/MF $0.50 CSCL 09B

Digital data processing necessarily involves quantization (roundoff) of input data. The statistical theory of amplitude quantization indicates that the effects of quantization on statistics are often negligible or can be approximately predicted and corrected, even with suprisingly coarse quantization. This tutorial paper reviews contributions to the theory made in England, the Netherlands, and Russia, as well as B. Widrow's original work in this country. Applications to remarkably inexpensive hybrid analog-digital averaging computers and correlators are also discussed. The theory can pay very handsome practical dividends: in many applications, 2- to 4-bit analog-to-digital converters and data-transmission channels can yield averages, mean squares, and correlation functions with 10- to 20-bit accuracy, and one-bit (polarity-coincidence) correlators are often practical. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-26694 Ebauches, S. A., Neuchâtel (Switzerland).
CIRCUIT FOR ELECTRONIC WATCH WITH BALANCE-HAIR-SPRING SYSTEM [CIRCUIT POUR MONTRE ELECTRONIQUE A BALANCIER SPIRAL]
R. W. Jeanmonod *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 473–478 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

A transistorized circuit for sustaining the oscillations of a spring balance must meet various conditions: (1) Maximum efficiency, so that the small quantity of energy contained in the dry cell that is built into the watch, is sufficient for at least one year's operation; (2) Operation insured between −20° C and +60° C, without any excessive alteration of the characteristics; and (3) Minimum cost. In obtaining these characteristics, the primordial part is of course played by the transistor. For about three years past, silicon transistors of the planar type have been available on the market, and these are highly suitable for our purpose. As for the other components of the circuit, the problem is comparatively easy to solve, thanks to the miniaturization which is now being achieved in electronics for the purpose of special applications. The circuit which we have developed has certain interesting features of its own. For example, the balance oscillations are self-starting and at normal amplitude, there is only one driving pulse per oscillation, which makes for better performances from the chronometric point of view. Author

N65-26698 Centre Electronique Horloger, S. A., Neuchâtel (Switzerland).
A FREQUENCY DIVIDER CIRCUIT AND ITS MICROMINIATURIZED VERSION [UN DIVISEUR DE FREQUENCE ET SA REALISATION MICROMINIATURISEE]
E. Vittoz and P. Gutknecht *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 515–525 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

Among frequency divider circuits those working on the principle of charge storage are intersting for horological applications since they offer the following advantages: operation at very low power level (of the order of microwatts); component values meeting the limitations of microminiaturisation; and small number of components required per stage. The system consists of a capacitor storing the charges delivered by a circuit at each period of the incoming signal. After n periods the voltage across the capacitor reaches a critical value and discharges through the ouput circuit, thus delivering an output pulse. This paper describes the operating principle of the circuit, the design and assembly of its microminiaturised version. Its basic elements are transistors, diodes, resistors and capacitors fauricated by the silicon planar process. The circuit is assembled on the ceramic base of a transistor can. The elements are interconnected with 18 micron gold wires. This technique, known as "hybrid technique" makes it possible to assemble the elements of this circuit on a total area of 25 mm^2 and to avoid further parasitic effects, which often plague fully integrated circuits. Author

N65-26933# SFD Labs., Inc., Union, N. J.
DEVELOPMENT OF AN X-BAND CW CROSSED-FIELD AMPLIFIER Interim Development Report, 30 Sep.–31 Dec. 1963
M. Arnum Jan. 1964 34 p ref
(Contract NObsr-89503)
(SFD-33-IDR-2; AD-429347)

Circular versions of slow wave structures capable of meeting the required specifications of the program have been evaluated at cold test. Major emphasis has been placed on obtaining comparative electronic interaction impedance values for the circuits and on obtaining an acceptable impedance match for the circuits across the frequency band of interest. Of particular significance is the fact that an interdigital line design with increased coupling impedance in comparison to that of the conventional interdigital line has been obtained. Construction of a second version of such a circuit has been initiated. The interaction impedance of this second version is expected to be further enhanced. Author

N65-26949# Electro-Mechanical Research, Inc., College Park, Md.
RADIATION TOLERANT VCO DEVELOPMENT PROGRAM Final Report, Nov. 1963–Feb. 1964
R. C. Powers [1964] 62 p
(Contract DA-49-186-AMC-33(X))
(AD-461422)

Results obtained with several variations of the basic tunnel diode voltage controlled oscillator (VCO) indicated that the design approach is sound, and that well-founded modifications can be made to the basic VCO circuit without affecting radiation hardness. Further, it was evident that nuvistor buffers, including cathode followers and pulse amplifiers, can be expected to operate reliably. The radiation tolerance of tunnel diodes, zener diodes, nuvistors, and various passive components was verified. It was concluded that a VCO capable of ±40% deviation about a center frequency of 750 kc, designed around

the basic tunnel diode circuit, can operate before, during and after a transient radiation environment. The VCO provides a reliable means of telemetering wide band data originating in an intense transient radiation environment. Further, the VCO meets the requirements of operation before, during, and following neutron and gamma transients of the magnitude and duration experienced in the Triga reactor. E.E.B.

N65-26950# Electromagnetic Technology Corp., Palo Alto, Calif.
DEVELOPMENT OF FILTER BANK ASSEMBLY Interim Development Report, 1–31 Aug. 1964
William A. Edson and Lyle C. Bacon 21 Sep. 1964 13 p
(Contract Nonr-4585(00) (X))
(IDR-3; AD-461896)

Work toward designing, fabricating, and testing a channelizing filter bank is reported. Technical information sufficient for the designing of the manifold for the filter band was developed. Omnispectra rigid coaxial cables were tested and found satisfactory. Insertion loss expected in various types of band-pass filters was estimated. Research continues on fabrication of experimental hardware to simulate the input manifold and cavities, search for improved and low cost subminiature connectors, study of transmission zero producing techniques, and preparation of specimens to test the bonding tensile strength of indium solder. J.M.D.

N65-26981# General Electric Co., Auburn, N. Y. Semiconductor Products Dept.
RESEARCH AND DEVELOPMENT OF SILICON CONTROLLED RECTIFIERS FOR HIGH FREQUENCY AMPLIFIER APPLICATIONS Quarterly Progress Report, 16 Jan.–16 Apr. 1965
[1965] 29 p ref
(Contract NObsr-91299)
(QPR-2; AD-615037)

Preliminary design information obtained from evaluating small interdigitated structures as well as test data gathered on large power SCR's have yielded two cathode geometry designs to be used in fabricating state-of-the-art devices. The steps of device assembly and the test equipment needed to evaluate the new devices are also discussed in this report. Author

N65-27036# Joint Publications Research Service, Washington, D. C.
THE MICROMODULE IS BORN
A. Klyuchnikov 29 Jun. 1965 11 p Transl. into ENGLISH from Radio (Moscow), no. 5, May 1965 p 50–52, 54
(JPRS-30854; TT-65-31375) CFSTI: $1.00

With the aim of familiarizing the radio amateur with the micromodule, general matters relating to its construction and manufacture as well as with the method for building circuits with an arrangement of micromodules are discussed. An example of the sequential stages and the special features of the construction of micromodules is developed for the circuit of a direct amplification receiver. Many circuit drawings are included, and the specifications for the microelements are tabulated. M.W.R.

N65-27080# Clevite Corp., Bedford, Ohio. Piezoelectric Div.
PRODUCTION ENGINEERING MEASURE FOR CERAMIC FILTERS Quarterly Report No. 8, 30 Dec. 1964–29 Mar. 1965
A. Lungo [1965] 29 p
(Contract DA-36-039-AMC-01471(E))
(Rept.-8; AD-615760)

An investigation of an improved resonator contact and resonator support concept was completed. The new concept replaces the circular contact springs with helical compression springs. The results of the investigation are presented and discussed. New package designs were initiated incorporating the helical compression springs. The progress of the new package designs is discussed. Several problems which are anticipated to occur during the manufacture of the preproduction filters and the production run of filters are presented and discussed. The status of the production fixture designs is presented. Author

N65-27099# Cornell Univ., Ithaca, N. Y. School of Electrical Engineering
INVESTIGATION OF LINEAR BEAM AND NEW CONCEPTS OF MICROWAVE POWER GENERATION
G. C. Dalman and L. Mac Kenzie Griffiss AFB, N. Y., RADC, Apr. 1965 58 p refs
(Contract AF 30(602)-3243)
(RADC-TR-65-22; AD-615756)

The interaction of magnetically focused electron beams with electromagnetic circuits, basic electromagnetic interaction circuits, electron beam phenomena, electron-beam plasma amplifier, and laser-stimulated electron emission are discussed. The feasibility of using biased electron beams to control phase shift in linear beam tubes is demonstrated. The research on magnetically focused electron beams included the results of experiments conducted on immersed-flow electron beams, and the effects of axially varying magnetic fields on beam properties. Experiments showing the presence of strong microwave interactions in a beam-generated plasma are also described. Basic probe measurements of electron densities and effective electron temperatures were made on an argon plasma identical to that used for the beam-plasma amplifier. Further, two applications of the laser-induced electron beam were considered: (1) the measurement of the beam-loading admittance; and (2) the active interaction in which a radio-frequency is propagated by the beam. E.E.B.

N65-27103# General Dynamics Corp., San Diego, Calif. General Atomic Div.
TRANSIENT AND DISPLACEMENT EFFECTS TESTS WITH AN ACCELERATOR PULSED FAST ASSEMBLY Technical Report, 11 Sep.–31 Dec. 1964
V. A. J. van Lint and J. W. Harrity Kirtland AFB, N. Mex., AF Weapons Lab., Mar. 1965 62 p refs
(Contract AF 29(601)-6662)
(AFWL-TR-65-2; AD-613702)

Displacement and ionization radiation effects tests were performed with an Accelerator Pulsed Fast Assembly and compared with linear accelerator and TRIGA pulsed reactor tests. Specific measurements were made on the annealing of beta degradation in npn and pnp silicon transistors and on the conductivity induced by a short neutron-gamma pulse in a 0.5 μF Mylar capacitor. The results indicate no measurable annealing of the damage in npn transistors, but a significant (factor of ~ 2) annealing with a decay time ~ 100 μsec in pnp transistors. The conductivity induced in the Mylar capacitor could be attributed predominantly to the gamma component and exhibited no unusual behavior due to the short neutron pulse. Author

N65-27142# Bell Telephone Labs., Inc., New York.
ENGINEERING SERVICES ON TRANSISTORS Seventh Quarterly Progress Report, 1 Oct.–31 Dec. 1964
C. R. Crowell, R. E. Davis, M. P. Lepselter, R. E. Maher, R. L. Pritchett et al [1965] 67 p refs
(Contract DA-36-039-AMC-02227(E))
(Rept.-19; AD-615584)

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N65-27143 Bell Telephone Labs., Inc., New York.
STATUS OF THE 6-Gc GERMANIUM TRANSISTOR
R. L. Pritchett and R. A. Maher *In its* Eng. Serv. on Transistors [1965] p 7–12 (See N65-27142 16-09)

Developments in the fabrication of the 6 Gc planar germanium transistors are reported. The use of a simplified two-oxide fabrication process resulted in a much higher yield of transistors suitable for radiofrequency measurements and characterization studies. Performance in the 3 to 6 Gc range was improved using this process. However, nonohmic base contacts still limit their over-all performance. R.N.A.

N65-27144 Bell Telephone Labs., Inc., New York.
CHARACTERISTIC IMPEDANCE OF STRIP TRANSMISSION LINE WITH INSERTED GROUND PLANES
R. J. Scudamore *In its* Eng. Services on Transistors [1965] p 13–22 refs (See N65-27142 16-09)

An analytical solution was derived for the characteristic impedance of a triplate stripline configuration with inserted ground planes coplanar with the center conductor. The calculated results agreed satisfactorily with experimental measurements. The solution is useful in designing matched stripline jigs for precise microwave measurements on transistors and in designing stripline transistor headers. R.N.A.

N65-27145 Bell Telephone Labs., Inc., New York.
BEAM-LEAD DEVICES
M. P. Lepselter *In its* Eng. Services on Transistors [1965] p 23–29 (See N65-27142 16-09)

A new technique for batch fabricating semiconductor devices with electroformed electrodes cantilevered beyond the edges of the wafer, and called beam leads, is described. The structure simplifies the assembly of individual units and integrated circuits, and is applicable to devices where photographically reproduced leads are beneficial. Photographs, illustrations of the fabrication steps, and features of the beam lead structure are included. R.N.A.

N65-27146 Bell Telephone Labs., Inc., New York.
BEAM-LEAD MULTICHIP CIRCUITS
M. P. Lepselter and R. E. Davis *In its* Eng. Services on Transistors [1965] p 31–36 ref (See N65-27142 16-09)

Two types of discrete component integrated circuits were built to demonstrate the feasibility of using beam lead devices. A 4-3 dual gate utilizing beam-lead resistors and transistors, and a 2-2-2 triple gate with beam-lead transistors appliqued to a ceramic substrate containing tantalum thin-film resistors were constructed. A linear amplifier designed for insertion into a 600-ohm line was also constructed using the latter technique. Experiments revealed no difficulties from either a transistor or resistor viewpoint. Propagation delays of 4.5 nanoseconds were measued in a three stage ring oscillator composed of 4-3 gates. Measurements on the linear amplifiers revealed 40-dB insertion gains and 5-kc to 1-Mc bandwidths at 3 dB. R.N.A.

N65-27147 Bell Telephone Labs., Inc., New York.
ISOLITHIC INTEGRATED CIRCUITS
M. P. Lepselter and H. A. Waggener *In its* Eng. Services on Transistors [1965] p 37–42 ref (See N65-27142 16-09)

An integrated direct coupled transistor logic circuit was fabricated by a new isolithic process which is essentially the same used for discrete component beam lead devices. Propagation delays of 4 nanoseconds were measured on a ring oscillator. Circuits withstood 135 000 g's applied normal to the plane of mounting, and 95 000 g's parallel to the plane of mounting. The isolithic technique offers a high degree of electrical isolation; suitability for the production of circuits having a fine spectrum of speed, from dc amplifiers to very high speed switching circuits; simplified handling, testing and assembly; and the choice of incorporating thin film resistors in the structure itself or on the circuit card to which isolith is appliqued. R.N.A.

N65-27148 Bell Telephone Labs., Inc., New York.
SURFACE-STATE AND INTERFACE EFFECTS IN SCHOTTKY BARRIERS AT N-TYPE SILICON SURFACE
C. R. Crowell *In its* Eng. Services on Transistors [1965] p 43–60 refs (See N65-27142 16-09)

Evidence regarding clean metal semiconductor contacts points to the validity of a model in which the metal and semiconductor are in intimate contact. The barrier height is determined by the semiconductor surface state density which is close to that for a free surface. The contact potential difference between the metal and the semiconductor exerts an additional effect on the barrier height. The size of this effect is determined by the fraction of the contact potential difference which occurs in the metal. A considerable decrease in semiconductor surface state density occurs for contacts using a monolayer of oxygen between the metal and semiconductor. A very large decrease is necessary to permit a large change in the size of the surface barrier by choosing metals with different work functions. A monolayer of oxygen does not reduce the surface state density of Si sufficiently to permit the large reduction in barrier height necessary to make a good ohmic contact to n-type Si. While water vapor reduces the Si surface state density adequately, it does not produce a stable contact. R.N.A.

N65-27177 Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET RESEARCH ON THE EFFECT OF HIGH PRESSURES ON SUPERCONDUCTIVITY
Dimitri Vvedensky *In its* Foreign Sci. Bull. Jun. 1965 p 18–22 refs (See N65-27175 16-29)

Soviet research on the effect of high pressures on the superconductivity of tallium, cadmium, zirconium, titanium, niobium-zirconium alloy, Nb_3Sn compound, and single-crystal bismuth is reviewed. Author

N65-27181# Union Carbide Corp., Parma, Ohio. Linde Div.
DEVELOPMENT OF THIN ORGANIC ROLLED FILM CAPACITOR Summary Report, Jun. 26, 1963–Dec. 26, 1964
[1965] 125 p
(Contract NObsr-89519)
(AD-615753)

The development program detailed and conducted with the object of creating a highly stable parylene film-extended foil capacitor is reported. Those procedures required to produce high quality parylene coated aluminum foil, as well as the capacitor fabrication and testing procedures, are described in detail. The feasibility of a metallized parylene capacitor is demonstrated. Various areas are recommended for additional development leading to improved capacitors of these types. Author

N65-27186# Army Electronics Labs., Fort Monmouth, N. J. Solid State and Frequency Control Div.
SUPERCONDUCTIVE TANK CRICUITS AS NETWORK ELEMENTS
Erich Hafner May 1964 31 p refs
(ECOM-2473; AD-615964)

The properties of superconductive tank circuits are examined from a network standpoint. As a specific example, the input impedance of a coaxial transmission line which is terminated by a capacitively coupled superconductive tank circuit is analyzed in detail as a function of frequency. The pronounced effect of the transmission line on the overall performance is demonstrated along with techniques to compensate for it. A set of equations is developed which can be used to determine the electrical parameters of the superconductive tank circuit and their variations with operating conditions from oscillator measurements. The design information required to build the test oscillator is also provided. The similarity between superconductive tank circuits and quartz crystal units is taken advantage of to illucidate the significance of some aspects of the analysis. Author

N65-27187# Cornell Univ., Ithaca, N. Y. Electrical Engineering Research Lab.
INVESTIGATION OF LINEAR BEAM AND NEW CONCEPTS OF MICROWAVE POWER. VOLUME III: BEAM–CIRCUIT INTERACTION
Cheng Sun and R. C. Sander Griffiss AFB, N. Y., RADC, Apr. 1965 223 p refs
(Contract AF 30(602)-3243)
(RADC-TDR-64-563, Vol. III; AD-615962)

Klystron efficiency enhancement and cross modulation and intermodulation amplitude distortion in klystron amplifiers were studied. Coupling coefficients, small signal and large signal beam-loading conductance, and input conditions of current and velocity modulation factors affecting the klystron efficiency were investigated. A small signal confined-flow theory is used to determine the coupling coefficient and beam-loading conductance for various circuits, while a large signal confined-flow theory is applied to the output cavities to calculate the large signal beam-loading conductance and klystron efficiency. Two-cavity klystron measurements were made with a demountable beam analyzer, and effects on efficiency of space charge, the position of output cavity, and output load were examined. In the cross modulation and intermodulation amplitude studies, experimental measurements of the output power levels at four frequencies were made on a two cavity, X-band klystron amplifier. The similarity between the cross modulation and intermodulation results obtained on two and three cavity klystron amplifiers, and those obtained on a traveling wave amplifier, leads to a general graphic-numeral method for determining the magnitude of these distortions in any amplifying device whose power transfer curve is precisely and accurately known. L.S.

N65-27194# Illinois Univ., Urbana. Antenna Lab.
DISPERSION CHARACTERISTICS OF A WAVEGUIDE WITH GLIDE REFLECTION SYMMETRY Technical Report No. 5
R. Mittra and S. R. Laxpati Feb. 1965 38 p refs
(Contract AF 19(628)-3819)
(ALR-65-2; AFCRL-65-161; AD-615827)

An exact formulation of the boundary value problem for an infinite lossless iris loaded periodic waveguide with glide reflection symmetry has been obtained for TM wave propagation. The characteristic equation for the fundamental propagation constant Γ is solved for real as well as complex roots. These solutions are plotted in the form of k-β diagrams. The effect of variation of certain parameters is studied. On the basis of the periodicity of the solutions for Γ it is demonstrated that the effective period of this structure is half of its translation period. A discussion of the k-β plots is presented and some comments on the properties of the complex waves in lossless periodic waveguides are included. Author

N65-27201# Hughes Aircraft Co., Newport Beach, Calif. Microelectronics Div.
THIN FILM MICROCIRCUIT INTERCONNECTIONS Third Quarterly Progress Report, 1 Oct.–31 Dec. 1964
Maurice Yang and Bob G. Bender Apr. 1965 43 p refs
(Contract DA-28-043-AMC-00052(E))
(Rept.-3; AD-615542)

Efforts to date to isolate, separate or nullify the effects of conductors and welds from the properties of the interconnects have been of marginal effect. Therefore the decision was made to abandon the original test pattern. New test patterns have been designed. Separate designs for AC measurements at 100 MC and 1000 MC and for DC tests have been conceived. Each pattern has been designed to eliminate the effects of the contacts and related pad areas. Design philosophy is detailed and initial measurements on an over size trial pattern have been made. An hypothesis to the asymmetrical breakdown voltages encountered with earlier Cr or CrAu electrodes has been evolved. Preliminary test results indicate that the breakdown voltage is markedly improved by the treatment suggested by the hypothesis. This treatment consists of the addition of oxygen to the process. Author

N65-27202# Michigan Univ., Ann Arbor. Electron Physics Lab.
INVESTIGATION OF LARGE-SIGNAL KLYSTRON AND TRAVELING-WAVE DEVICES Quarterly Progress Report No. 1, 1 Sept.–30 Nov., 1964
G. T. Konrad, J. E. Rowe et al Griffiss AFB, N. Y., RADC, Mar. 1965 53 p refs
(Contract AF 30(602)-3569)
(RADC-TR-64-585; AD-615150)

A general nonlinear two-dimensional interaction theory is employed to analyze Brillouin flow in the presence of large-signal r-f on the circuit. Finite values of axial magnetic field and radial variations of both the circuit and space-charge fields are assumed. The present status of the nonlinear boundary-value problem solution for electron and plasma devices is

described. The computer program is ready for checkout. Considerations in the initiation of two experimental programs are described. One is a study of beam stability in the presence of large r-f fields, while the second deals with velocity distribution effects on the start-oscillation conditions of BWO's. Results of cold tests made on several ring-and-bar circuits are summarized. Calculations on a phase-focused ring-and-bar tube are initiated. Two digital computer programs for the solution of electron guns are being worked on. The first deals with magnetron injection guns and is shown not to be reliable as yet. The second one is concerned with relativistic electron beams. This program is ready for checkout. Preliminary work on the design of a tube for checking the noise properties of a beam obtained from a magnetron injection gun is described. Design considerations for a noise transformer are given. Author

N65-27242 Joint Publications Research Services, Washington, D. C.

PARAMETRIC AMPLIFIER WITH TRANSVERSE INTERACTION AND ELECTROSTATIC FOCUSSING OF THE ELECTRON CURRENT

V. I. Yur'yev *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 197–209 refs (See N65-27225 16-34) CFSTI: $6.00

The possibility in principle of constructing a parametric amplier with transverse interaction and electrostatic focussing of the electron current is shown. Systems proposed previously are used as the signal-current coupling element. The characteristics of the amplifier and the dependences of a number of parameters are presented. Author

N65-27308# General Instrument Corp., Darlington, S. C. Capacitor Div.

PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID TANTALUM CAPACITORS Quarterly Report, Jun. 29–Sep. 28, 1964

Floyd R. Banks, Jr. and A. Di Giacomo [1964] 22 p
(Contract DA-36-039-AMC-03622(E))
(QR-5; AD-615097)

This, the Fifth Quarterly Report on the Contract, presents a concise statement of the work performed during this reporting period. The primary areas of process improvement studies were: (1) anodizing and re-forming; (2) carbon and silver coating; and (3) ageing. Tests of significance were performed on twelve combinations of process variables which were studied during this period; the variables were: (1) re-form voltages; (2) the number of carbon coats; and (3) carbon curing temperatures. Two primary conclusions derived from the work are: (1) Lot 1939, with the higher re-form voltage compared with Lot 1940, has a significantly lower average capacitance and dissipation factor, and somewhat higher d-c leakages; and (2) capacitors with 2-carbon coats and the 150° C cure have lower average d-c leakages compared with the 125° C cure on Lot 1040, whereas the converse is true for Lot 1939. Author

N65-27312# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.

CYCLOTRON WAVE DEVICES

Bruno Zotter Mar. 1965 21 p refs
(ECOM-2560; AD-614776)

The different types of electron beam waves are discussed and illustrated by examples of mechanical waves. The concept of positive and negative energy is introduced and its relationship to active and passive coupling investigated. The low-noise Adler tube and the diftron tube are described, as well as several possibilities of using transverse wave tubes as high-efficiency amplifiers. The use of these schemes in current microwave applications is discussed. Author

N65-27314# Army Electronics Lab., Fort Monmouth, N. J. Electron Tubes Div.

THIN-FILM PREPARATION

Dietrich Dobischek and Stanley Cabell Feb. 1965 27 p
(ECOM-2573; AD-614779)

Vacuum deposition techniques for the preparation of thin films were investigated and developed to a point where a study of the usefulness of these structures as tunnel emitters is now feasible. The described experimentation with Al-ZnS-Al, Mg-MgO-Mg, and Al - Al_2O_3-Al structures will eventually lead to a study of the combination Al-Al_2O_3-Au sandwich, with special attention given to the method of forming the oxide film and to the geometry of the structure. A method of monitoring the thickness of thin films during deposition by means of an oscillating quartz crystal was investigated. Although the results proved promising, a decision on the final capabilities of this method cannot be made until calibration tests are completed and the reproducibility of the results is established. The usefulness of the electrolytical anodic oxidation technique for the preparation of thin insulating oxide layers was investigated. Preliminary experiments were conducted on various sheet metals. The investigation is presently concentrated on the oxidation of vacuum-deposited films of aluminum and the formation of special patterns using photoresist masking techniques. Author

N65-27315# Army Electronics Labs., Fort Monmouth, N. J. Power Sources Div.

UNSYMMETRICAL LOW-VOLTAGE CONVERTER

William L. Dudley Jan. 1965 19 p refs
(ECOM-2574; AD-615115)

The theory of converting the low output voltages generated by energy conversion devices to useful higher voltages by means of an unsymmetrical electrical converter is discussed. The design and development of an experimental converter are described. Performance characteristics of the converter are interpreted in relation to feasibility of the concept. Author

N65-27323# Technical Research Group, Inc., Syosset, N. Y.

DEVELOPMENT OF A LOW-NOISE MILLIMETER-WAVE PARAMETRIC AMPLIFIER Sixth Quarterly Progress Report, 1 Oct.–31 Dec. 1964

B. Albrecht, J. Kliphuis, and D. Neuf Fort Monmouth, N. J., Army Electronics Command [1964] 22 p
(Contract DA-36-039-AMC-02365(E))
(Rept.-6; AD-615162)

Room-temperature impedance measurements made on several subminiature surface-barrier varactors with etched substrate surfaces indicate a significant improvement in performance at 90 Gc over that previously obtained with larger diodes having unetched substrates. However, the resulting cut-off frequencies of the etched varactors are still well below the value required for gain at 90 Gc. A breadboard 94-Gc amplifier mount has been fabricated that exhibits low loss at the signal and pump frequencies. Further tests on this amplifier cannot be made until a higher cut-off frequency diode is available. Author

N65-27331# General Telephone and Electronics Labs., Inc., Bayside, N. Y.

SEMICONDUCTOR MICROWAVE AMPLITUDE AND PHASE MODULATOR Seventh Quarterly Report, Nov. 16, 1964–Feb. 15, 1965

R. Harrison, J. Zucker, F. Drago, and D. Fleri [1965] 20 p ref /ts Rept.-7
(Contract DA-36-039-AMC-02284(E))
(TR-65-103.7; AD-615328)

Experiments on the amplitude modulator were extended into the uhf range. Typical measurements on experimental epitaxial silicon diodes yielded modulation indices of approximately 50 percent at 220 Mc/s and approximately 15 percent at 400 Mc/s. This decrease in modulation depth with increasing modulation frequency appears to be due to the frequency sensitivity of the wafer in which the diode is mounted. A new test structure has been designed which will enable a more accurate and reliable measurement of the equivalent circuit parameters of the PIN diode at 70 Gc/s. This unit is presently being fabricated. An experimental method was established for tuning the varactor phase shifter for maximum phase shift. This condition of tuning does not correspond to minimum insertion loss. In the 70-Gc/s hybrid ring configuration 50 degrees of phase shift was obtained with a 3.4 dB insertion loss. A method for coating the surface of the point-contact GaAs varactors with a thin epoxy film was developed in an effort to improve varactor stability. Initial tests on fourteen diodes treated in this manner show promising results. Author

N65-27333# General Electric Co., Syracuse, N. Y.
DEVELOPMENT OF HELICAL PHASE-SHIFTERS Final Report
Hugh A. Hair Dec. 1964 108 p refs Prepared for Lincoln Labs.
(Contract AF 19(628)-500)
(AD-614069)

A new type of latching phase-shifter is discussed which makes use of a shielded helix as a microwave circuit. With emphasis on the developmental aspect of the phase-shifter, the following areas are discussed: (1) phase-shifter theory of operation; (2) temperature sensitivity and saturable core driver techniques; (3) peak and average power capabilities; (4) ferrite and dielectric materials for L- and S-band frequencies; (5) S-band high power phase-shifter; and (6) magnetization-temperature characteristics of various commerical materials.
N.E.A.

N65-27338# Microwave Electronics Corp., Palo Alto, Calif.
X-BAND HIGH POWER CW AMPLIFIER AND AMPLIFIER CONSOLE Sixth Quarterly Progress Report, 1 Oct.–31 Dec. 1964
Alan W. Scott, Norman H. Pond, and Robert E. Eggers [1964] 21 p
(Contract DA-36-039-AMC-03334(E))
(Rept.-6; AD-615001)

Efforts to develop a 12.5 kilowatt continuous wave traveling-wave tube covering the frequency range frrom 7.7 to 8.4 gigacycles for use in ground stations for satellite communications are described. Tubes were fabricated and evaluated, and the amplifier consoles for their operation were tested and reworked. An efficiency taper was incorporated into a continuous wave tube and did improve its efficiency. Oscillation problems prevented the continuous wave operating of the tubes. However, the oscillations were controlled by driving the tubes and useful test data was obtained. Measurements show that efficiency was improved by a factor of 1.3 to 1.5 and that the oscillation problem can be solved. The tube life testing consoles were plagued with component failures and spurious turn-offs due to the highly sensitive circuits designed to operate the crowbar within microseconds after a fault. R.N.A.

N65-27344*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ANALOG TO DIGITAL CONVERTER FOR THE S-57 ION-CHAMBER EXPERIMENT
Joseph C. Thornwall Washington, NASA, Jul. 1965 20 p refs
(NASA-TN-D-2825) CFSTI: HC $1.00/MF $0.50 CSCL 09C

This paper describes the circuits used in an analog-to-digital (A-D) converter designed for satellite application. The average power requirements are minimized by using linear and nonlinear magnetic circuits wherever possible. The analog input voltage is encoded by sequential comparisons with a reference voltage. The sequencing is accomplished with one-bit magnetic ring counters and the reference voltages are generated and summed in windings of blocking oscillator transformers.
Author

N65-27378*# ITT Electron Tube Div., Easton, Pa.
DEVELOPMENT OF ELECTRONICALLY TUNABLE CONVERTERS IN THE MILLIMETER WAVE RANGE Final Report, 16 Jul. 1963–16 Nov. 1964
R. J. Kenyon [1964] 161 p refs
(Contract NASw-790)
(NASA-CR-63630) CFSTI: HC $5.00/MF $1.00 CSCL 09A

In an effort to fabricate backward-wave converters for the millimeter region of the spectrum, four major tasks were researched: 1) the effect of varying intermediate frequency on the conversion gain of a single circuit conductor; 2) determination of the characteristics of ridge-loaded meander line circuits partially or totally wrapped into circular configuration; 3) design and construction of three backward-wave tubes in the 50 to 75 Gc/s frequency range, each of which can be operated as an oscillator, amplifier, or single circuit converter; and 4) design and construction of three experimental double circuit backward-wave converters for operation in the 50 to 75 Gc/s range. It was found that a meander line deformed to accommodate cylindrical beams can be a usable millimeter wave, slow wave circuit and that swept receivers for low signal levels require a double circuit rather than a single circuit converter. M.W.R.

N65-27415 European Organization for Nuclear Research, Geneva (Switzerland). Nuclear Physics Div.
THE ELECTRONIC LOGIC SYSTEM USED WITH THE MAGNETIC SPARK CHAMBER
W. Beusch 31 May 1965 33 p refs
(CERN-65-21)

An electronic logic system, which operates by simple plug-in units that are dc coupled and work on standard signal voltages, has been found to be useful and reliable in test and production runs with the magnetic spark chamber. Main units of the system are a discriminator and a limiter for photomultiplier pulses, a fivefold coincidence unit, a fan-in circuit with or without inversion, and a fourfold fan-out. Each of the units has independent outputs which facilitate the construction of a logic with a minimum of elements. The step function output results in good anticoincidence efficiency, a free choice of coincidence and anti-coincidence time resolution, the possibility of using a simple trigger display system, and no multiple outputs for long signals. Results indicate that the system permits a reasonably good time resolution, 5 nsec fwhm, with a very good plateau efficiency. M.W.R.

N65-27527# Space Technology Labs., Inc., Redondo Beach, Calif.
THE RELATIONSHIP BETWEEN A LOGARITHMICALLY SWEPT EXCITATION AND THE BUILD-UP OF STEADY STATE RESONANT RESPONSE

R. E. Morse Dec. 1964 62 p refs
(Contract AF 04(694)-550)
(STL-7120-6154-RU000; AD-465612)

Common practice in the dynamic environmental qualification and acceptance testing of electronic equipment is to use sinusoidal vibration excitation that is logarithmically swept throughout a wide range of frequencies. With this logarithmic sweep, the equipment under test is exposed to vibration excitation an equal amount of time in each octave frequency band. For slow sweep rates, the resonant build-up in a dynamic system is the same as the steady-state resonant response for all practical purposes. This report presents an exact mathematical solution for acceleration response to the logarithmically swept sinusoidal vibration excitation for a viscously damped single degree of freedom dynamic system. Since this mathematical solution is in a form not readily applicable for engineering use, an analog simulation is presented from which readily usable results can be obtained. The relationship between the sweep rate and the percent of steady-state resonant response is determined. Author

N65-27538# Stanford Univ., Calif. Microwave Lab.
MULTIMEGAWATT BROADBAND MICROWAVE TUBES AND RELATED STUDIES Final Report, 1 Nov. 1963–31 Oct. 1964
Arthur J. Frolich Griffiss AFB, N. Y., RADC, Mar. 1965 50 p refs
(Contract AF 30(602)-2575)
(ML-1264; RADC-TR-65-583; AD-615014)

The report summarizes the contract year. Individual abstracts for each task are as follows: I. Extended Interaction Klystrons: The small signal performance of a three-cavity extended interaction klystron operating in conjunction with the electron stick at 25 Kv, 1100 Mc is presented. II. Centipede TWT: Amplitude and phase characteristics within the coupled cavities are presented. III. Transverse Wave Studies: An analytical analysis of transverse wave propagation on an accelerated beam in an axially magnetic field is presented. IV. Whistler Mode Propagation in Solids: Preliminary calculations and discussion are presented. V. Carrier Wave Propagation in Solids: Preliminary results on a study of the Gunn effect are presented. VI. Acoustic Wave Devices: Progress in thin film coupler techniques is presented. Author

N65-27540# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.
A TAPE RECORDER NEGATIVE-TIME AND TRANSIENT TRIGGER SYSTEM
R. I. Rubinstein and Martin L. Long, Jr. Oct. 1964 21 p refs
(ECOM-2519; AD-614778)

A Negative-Time and Transient Triggering System (NETATT), developed by the authors, has improved the systematic playback of transient phenomena stored on magnetic recording tape. A specific recorded trigger signal previously required to initiate the oscilloscope display of the recorded transient phenomena is no longer necessary. The NETATT System described herein utilizes the passage of the transient phenomenon or any other simultaneously recorded transient signal across the recording head of the tape recorder as the trigger. Since the recording head in most tape recorders precedes the playback head, the system significantly increases the amount of pre-transient display available and permits the experimenter to locate the displayed transient on any preselected portion of the oscilloscope screen at varying sweep speeds without the loss of desirable information. The NETATT System provides many of the advantages of a tape searcher without incorporating its disadvantages. The NETATT System, which has a negligible cost and complexity, is capable of performing functions that are impossible to perform with a tape searcher. The specific transient radiation effects observed on a photomultiplier tube with the NETATT system are described. Author

N65-27542# Controls for Radiation, Inc., Cambridge, Mass.
DEVELOPMENT OF RADIAC SET AN/TDQ-2 FOR DETECTION OF PULSED X-RADIATION FROM HIGH POWERED ELECTRONIC EQUIPMENT
Richard C. Mc Call and Alfred C. Jesins Griffiss AFB, N. Y., RADC, 30 Mar. 1965 59 p ref
(Contract AF 30(602)-2791)
(RADC-TDR-64-259; AD-614832)

A remote area monitor was developed for the purpose of detecting and measuring steady or pulsed x-radiation emission from high powered electronic equipment associated with radar installations. The system consists of six detectors connected to a central console by 250' cables. Each detector consists of a two foot square plastic scintillator coupled to a plastic light pipe which converges to a single photomultiplier, an internal calibration source and an amplifier. RF shielding is also provided. The central console utilizes six interchangeable modules with five decade logarithmic scales to indicate the radiation dose-rate from 1 milliroentgen/hour to 100 roentgen/hour. A push button switch is incorporated for each channel to check the calibration of the detector. In addition, an alarm system in the console provides both visual and audible signals when any one detector exceeds a pre-set radiation level. A fail-safe circuit was designed which indicates failure of detector operation by means of a bright light mounted on each module. The entire system was designed to operate on its own emergency power supply during power failure of up to 50 hours. Author

N65-27548# General Telephone and Electronics Labs., Inc., Bayside, N. Y.
NONLINEAR SEMICONDUCTORS AT MILLIMETER FREQUENCIES Quarterly Report No. 7, 1 Dec. 1964–28 Feb. 1965
R. I. Harrison, E. Conwell, F. Drago, O. Fleri, C. R. Smith et al 31 Mar. 1965 28 p
(Contract DA-36-039-AMC-02300(E))
(TR-65-102.7; AD-615341)

Measurements of the noise figure of an experimental 70-Gc/s receiver incorporating InSb hot-carrier mixers at 77° K were undertaken. The initial results indicate that the noise figure of this receiver is approximately 6 dB higher than that of the same receiver using a Schottky barrier mixer at room temperature. A 70-Gc/s hot-carrier detector was designed and constructed which exhibited square-law behavior for rf power levels up to 5 mW. A reliable experimental technique for measuring the characteristics of the hot-carrier modulator at uhf was established. Measurements on a typical unit yielded modulation indices of 80 percent at 220 Mc/s and 40 percent at 400 Mc/s. The insertion loss of the modulator was 4.5 dB. Author

N65-27553# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.
SEMICONDUCTOR REFLECTION-TYPE MICROWAVE MODULATOR
H. Jacobs, R. W. Benjamin (Monmouth Coll.), and D. A. Holmes (Carnegie Inst. of Tech.) Feb. 1965 28 p refs
(ECOM-2556; AD-615113)

A new type of microwave modulator has been designed in which it is predicted that relatively large modulation depths can be achieved. This device has been developed as an amplitude modulator and has promise in phase modulation. The

principles underlying its action depend upon reflections of microwaves from a low conductivity dielectric block short-circuited on the far end. The dielectric having the properties of frequently used semiconductors at a frequency of 10^{10} cycles per second forms a resonant cavity structure which provides a large amount of absorption at critical conductivities and length. Author

N65-27582# Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Research Lab.
MOLECULAR BEAM VELOCITY DISTRIBUTION MEASUREMENTS
Paul B. Scott Feb. 1965 183 p refs
(Contract Nonr-3963(03); Grants AF-AFOSR-131-63; AF-AFOSR-131-64; ARPA Order 322-63)
(MIT Fluid Dyn. Res. Lab.-65-1; AFOSR-65-0192; AD-614230)

The velocity distribution of the rebounding beam of molecules was measured and compared to the velocity distribution of the incident molecular beam. The measurement was made by the time of flight method. The molecular beam density at a distance downstream of the shutter was sensed by the electron beam ionization and ion collection. It was shown that the thermodynamic fluctuation effect limits the signal resolution of the instrument. To improve the resolution of the instrument, a phase selective integrator was developed which improved the signal-to-noise ratio from one to two orders of magnitude. Measurements of the incident molecular time of flight distributions showed agreement with the Maxwellian theory of a helium beam, and a deficiency of low velocity molecules for nitrogen and argon beams. Reflected beam measurements using a polycrystalline nickel surface showed that at high target temperatures, the thermal accommodation coefficient of air was 0.68, and of helium was 0.06. Accommodation coefficients for helium and air on nickel were in agreement with other data. There was little evidence for a non-Maxwellian velocity distribution in the reflected molecular beam, but it was noted that the portion of specular reflection was increased by heating the target. R.W.H.

N65-27593# Michigan Univ., Ann Arbor. Electron Physics Lab.
VELOCITY TAPERING IN MICROWAVE AMPLIFIERS
J. E. Rowe and C. A. Brackett Griffiss AFB, N. Y., RADC, Mar. 1965 45 p refs *Its* Tech. Rept.-81
(Contract AF 30(602)-3569)
(RADC-TR-64-554; AD-614244)

The low to moderate r-f conversion efficiencies characteristic of kinetic energy conversion devices may be enhanced by appropriately tapering the r-f circuit phase velocity. The nonlinear interaction equations have been solved in closed form for an HKB (hard-kernel-bunch) model to obtain an optimum taper form. Several velocity taper forms have been investigated in experimental amplifiers and the power output, gain, efficiency and phase shift characteristics of these amplifiers are discussed in detail. Conversion efficiencies up to 50 percent and near constant output power for a 20 db variation in r-f drive power have been realized in near optimally tapered circuit amplifiers. Further improvements realized include operation at a single voltage for maximum gain and power output and a nearly linear phase shift characteristic for a ± 10 percent voltage modulation. Author

N65-27594# Radio Corp. of America, Princeton, N. J. RCA Labs.
CESIUM VAPOR CATHODE STUDY Final Report, Dec. 2, 1963–Nov. 30, 1964
L. S. Nergaard, S. Bloom, A. L. Eichenbaum, and H. Sobol Griffiss AFB, N. Y., RADC, Apr. 1965 49 p refs
(Contract AF 30(602)-3241)
(RADC-TR-65-2; AD-614648)

Cesium-plasma cathodes have been studied as sources of very high-density electron beams. The common-emitter type of cathode using a highly directed cesium-vapor flow has been used to obtain a beam with a density of 800 A/cm^2. The beam was accelerated to 1.2 kV without any occurrence of voltage breakdown or instabilities. The electron temperature is twice the cathode temperature. A continuous current of 7 A has been extracted from a common-emitter cathode. It was possible to extract all emitted electrons from all common-emitter tubes tested. The separate-emitter type of tube with properly activated cathodes and directed vapor flow should provide beams with densities of 100 A/cm^2. Calculations have been made describing the stability and electron extraction from effusing, synthesized plasmas. Comparisons of theoretical and measured results are in fair agreement. A silver chloride seal has been shown to be a long-life seal for a tube using hot cesium vapor. Author

N65-27646# Microwave Associates, Inc., Burlington, Mass.
HIGH POWER SEMICONDUCTOR TR DEVICES Sixth Quarterly Progress Report, 1 Oct.–31 Dec. 1964
R. H. Brunton, III [1964] 36 p
(Contract DA-36-039-AMC-03187(E))
(Rept.-6; AD-614573)

Experimental work on the X_L band switch has resulted in the fabrication, design, and delivery of the first experimental model. This model has shown the feasibility of designing a PIN high power switch and achieving the design goals. The K_U band limiter effort was concentrated on improving the low level band pass characteristics and insertion loss; however, the high power leakage performance was greater than desired. New varactor diodes were obtained through evaluation of many varactors manufactured under different and new processes. These diodes showed promising results in higher power operation, improved insertion loss, and isolation performance. An all varactor limiter model was fabricated, tuned, and tested; results show that the spike leakage energy is negligible and the recovery time is less than 50 nanoseconds. R.W.H.

N65-27694# Joint Publications Research Service, Washington, D. C.
TRANSISTORIZED TENSOMETRIC AMPLIFIER
R. S. Orlov and O. Ye. Guzeyev 9 Jul. 1965 5 p Transl. into ENGLISH from Byull. Eksptl. Biol. i Med. (Moscow), no. 4, Apr. 1965 p 117–118
(JPRS-30997; TT-65-31495) CFSTI: $1.00

A small transistorized tensometric amplifier for simultaneous synchronous recording of mechanical muscle activities with registration of the biopotentialities on cathode or loop in electrophysiological studies on the heart is described. Tensometric pickups are glued on a metal plate whose resilience is selected to correspond to the strength of the muscle being studied. Flexure of the plate causes a deformation of the tensometric pickups resulting in bridge unbalance and a voltage difference in its diagonal, the intensity of which is proportional to the strength of the plate flexure and its angle of deflection from the original position. The difference in voltage is amplified by a differential amplifier based on two transistorized triodes and fed to the input of the cathode amplifier or the eighth loop of the oscillograph. The differential transistorized amplifier possesses better stabilization of the zero position and has no constant component at the output. R.N.A.

N65-27741# Electronic Systems Div., Bedford, Mass. Technical Requirements and Standards Office.
RELIABILITY RESPONSIVENESS IN TECHNICAL PROPOSALS
Milton V. Ratynski Dec. 1964 28 p
(ESD-TDR-64-667; AD-610605)

Technical proposals for military electronic systems, projects and equipments are now critically reviewed by Air Force Evaluation Boards for design-for-reliability. Reliability is a major design factor that must be considered in the initial system planning, during the design and development phase, and throughout the manufacture, site installation and checkout, and test cycle. Prospective contractors are required to clearly demonstrate in their proposals that the proposed configuration will meet the specified military reliability requirements. This report discusses and details those factors which must be developed by prospective contractors to assure responsiveness to the reliability/quality aspects. Although the emphasis is on electronic systems and equipments, the basic precepts described are readily adaptable to all Air Force systems and equipments. Author

N65-27752# International Resistance Co., Philadelphia, Pa. Documented Reliability Div.
RELIABLE LONG LIFE COMPONENT STUDY: XLT METAL FILM RESISTOR Final Technical Report, 30 Nov. 1961–15 Oct. 1964
Rodger Blackwell [1964] 83 p
(Contract DA-36-039-SC-88961)
(AD-615977)

To develop a method for estimating failure rate of a metal film resistor at various levels of power loading and ambient temperature, a matrix design was evolved which stressed device performance at 1/4 watt or two times the rated power level of the resistor. In the main cell, operated at 1/4 watt and 125° C, a maximum failure rate of 0.003%/1000 hr was estimated at 60% confidence over 10000 hr of testing. A mathematical model was designed to describe the behavior of the resistor under various power and temperature levels. Maximum failure rates, obtained through trade-off factors derived from the model, were 0.0008%/1000 hr at 1/4 watt and 125° C and 0.0003%/1000 hr at 1/4 watt and 85°C, where the failure definition is $\Delta R = \pm 2\%$. Both the mathematical model and available data conclude that, where other conditions are the same, a larger $\% \Delta R$ results when the test voltage is applied continuously than when the voltage is cycled 1-1/2 hr on and 1/2-hr off. It was further shown that the rate of change of resistance with time at a given stress is a function of the batch behavior of the resistor. M.W.R.

N65-27756# United Aircraft Corp., Windsor Locks, Conn. Electronics Dept.
ENHANCED MICRO-MODULE INTERCONNECTIONS: AN HERMETIC PACKAGING SYSTEM FOR THE INTEGRATION OF MICRO CIRCUITS Fifth Quarterly Report, 1 Jul.–30 Sep. 1964
R. Collins and D. J. Garibotti [1964] 70 p refs
(Contract DA-36-039-AMC-03620(E))
(HSER-3053; AD-611284)

The adaptation of previously developed techniques into manufacturing processes has been successfully completed. These processes were subjected to operation checkouts to establish compatibility with the objective of the programs which is to establish production capability of manufacturing the Enhanced Micro Modules on a pilot line basis at the rate of 100 units per eight hour shift. The proposed Microwafer Design Guide, the preliminary cost analysis of the completely assembled Enhanced Micro Modules and a manual describing the Inspection and Quality Control Procedures to be used in the production of the Engineering Model Design Modules were prepared and delivered as per contractual requirements. All equipment necessary in the fabrication of microwafers have been installed and subjected to operational checkouts. The machines which will be used in the assembly of the Enhanced Micro Modules have been installed and developed into operational units. The design and construction of a semi-automatic wafer inspection machine was completed. Author

N65-27767*# General Electric Co., Philadelphia, Pa.
DIGITAL LOGIC FAMILY STUDY Final Report
D. F. Hoeschele and G. E. Huffman Aug. 1964 271 p Prepared for JPL *Its* Doc.-64-SD-4331
(Contracts NAS7-100; JPL-950930)
(NASA-CR-63704) CFSTI: HC $6.00/MF $1.50 CSCL 09A

The analytical design and testing of a flip-flop and Nand gate suitable for use in many spacecraft electronic subsystems are described. The analysis was made for 500 kc and 50 kc devices with particular emphasis on part reliability and minimum power dissipation in the circuitry. The electrical specifications of the circuits are given together with the environmental and power supply voltage variations which can be tolerated. A transient analysis using charge techniques was used to determine circuit delay, rise, and fall times. The validity of the analytical dc- and transient-approaches taken in the circuit design was confirmed by tests under given operating conditions. The measurement data gave good agreement with calculations. E.E.B.

N65-27792# Harry Diamond Labs., Washington, D. C.
PRELIMINARY EVALUATION OF EXPERIMENTAL UHF SEMICONDUCTOR DIODE
Einar Naess 15 Oct. 1964 14 p refs
(HDL-TM-64-26; AD-610630) CFSTI: $0.50

A new high-voltage UHF detector semiconductor diode has been developed for HDL by hp associates, based on an extension of their "hot carrier" techniques. Preliminary evaluation of the diode (hpa 2018) showed that excellent detector performance at 500 MHz as well as "turnon" and "turnoff" characteristics are achieved with this diode. Other measurements indicate that good detector performance extends into the lower GHz range. The diode, which is rated at a minimum peak inverse voltage of 100 V and a junction dissipation of 100 mw is presently available from hpa in sample quantities. Estimates have been made for large-quantity low-cost production. Author

N65-27799# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
PLANARIZED GERMANIUM SWITCHING TRANSISTOR Final Report
Doyle Granberry, Warren P. Waters, and R. L. Petritz 30 Jul. 1964 34 p refs Prepared for MIT Lincoln Lab.
(Contract AF 19(628)-500)
(Rept.-03-64-52; AD-610606)

A planar process has been developed for fabricating germanium microwave switching transistors with electrical characteristics comparable to the best three-stripe mesa structures. These characteristics include a cut-off frequency averaging 2.5 Gc and a base resistance of less than 50 ohms with operating capability up to 100 ma. The planar process solves the problem of producibility inherent in the three-stripe mesa process. Ultra-high-speed switching transistors can now be built in large quantities for lower prices. In addition, the planar process affords a considerably enhanced reliability with the junctions protected by layers of SiO_2. Author

N65-27801# Microwave Electronics Corp., Palo Alto, Calif.
A THREE-WATT LOW-NOISE TRAVELING-WAVE TUBE FOR C-BAND Interim Development Report, 1 Oct.–30 Dec. 1964
Jan. 1965 20 p
(Contract NObsr-91322)
(IDR-2; AD-610387)

The 2700-volt helix design and the magnetron injection gun design, for this helix, were completed. Fabrication of two vacuum envelopes was started. A preliminary periodic-permanent magnet focusing structure design was completed; based on this design, the package was designed and fabricated. Computer trajectory and noise figure calculations were done for several cathode half-angles and magnetic fields. Author

N65-27810# Joint Publications Research Service, Washington, D. C.
PHOTO-ELECTRIC DEVICES
I. N. Shetalov et al 9 Jul. 1965 14 p ref Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 50, no. 4, Apr. 1964
(JPRS-31012; TT-65-31510) CFSTI: $1.00

An automatic photoelectric device, based on the method of synchronous recording, but incorporating a scanning beam principle in the system, is described. The device is used for statistically processing electrophysiological reactions. The electric circuit of the scanning beam system is given. Another photoelectric device is described which combines several physiological indexes thereby permitting simultaneous photographic recording of rapid and slow processes. An experiment on pulmonary reception in thoracotomized cats, making use of the device is described. During the experiment it was necessary to record simultaneously the components of artificially elicited potential of the vagus nerve with an ENO-1 oscillograph, cardiac contractions on an electrocardiograph, artificial respiration with Marey capsules, and tonus of smooth pulmonary musculature with a water manometer. A diagram of the camera device photographing the processes is presented. L.S.

N65-27828*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN ELECTROSTATICALLY DRIVEN DYNAMIC CAPACITOR
R. R. Locke 15 Jul. 1964 32 p refs
(Contract NAS7-100)
(NASA-CR-63731; JPL-TM-33-178) CFSTI: HC $2.00/MF $0.50 CSCL 09A

In the measurement of very small currents (i.e., 10^{-13} amp), the vibrating-capacitor electrometer can be considered a pre-eminent instrument. But, because of the prohibitive weight of most vibrating capacitors, this type of electrometer has been limited primarily to laboratory applications. This Report introduces a vibrating capacitor that weighs approximately an ounce and is roughly the size of a power transistor, which makes it ideally suited for space-flight applications. A description of the capacitor's fundamental operating principles, its function as part of an electrometer amplifier, and the history of its development to date is presented. Although most of the major problems of the vibrating capacitor have been overcome, effort is continuing to refine further the pickup transducer, the method of mounting, and the technology related to the control of contact potential. Author

N65-27853# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELEMENTS OF AN ELECTROLUMINESCENT SCREEN
I. Ya. Lyamichev 13 May 1965 25 p refs Transl. into ENGLISH from Tekhn. Kino i Televideniya (Moscow), no. 2, 1962 p 37–48
(FTD-TT-65-30/1+2; AD-616268)

Electroluminophore screens are evaluated for use in electroluminescent instruments. Arrangements of an element of a screen are considered for transformation of an electric signal into a visable image of necessary brightness. Elementary methods for connecting a seignetto electric to an electroluminescent capacitor are studied. The use of silicon diodes in the role of nonlinear element, and connection of screen elements to matrix schemes, are investigated. It was found that systems without nonlinear elements are of no practical importance since they do not allow sufficient information accumulation. Combination of in-parallel connected active and nonlinear resistances considerably raises the time of information accumulation, and allows increase in brightness of screen elements by several magnitudes in comparison with a screen without accumulation. J.M.D.

N65-27892# Midland-Wright, Kansas City, Kansas.
MODERATE PRECISION GLASS ENCLOSED CRYSTAL UNITS Ninth Quarterly Progress Report, 1 Apr. – 30 Jun. 1964.
Robert Kinsman [1964] 27 p ref
(Contract DA-36-0390-SC-86717)
(CR-(XM-44) /u; AD-610825)

The third set of engineering sample crystals was completed with certain design changes to improve the aging characteristics. These changes consisted primarily of using a polished blank rather than a semipolish as used previously. The process designs for this set of engineering sample crystals are tabulated. All crystals were mounted in tab clip type HC-27/U bases and were bonded with bakelite cement. The output of the crystal test set was fed into a times ten frequency multiplier and measured with a frequency counter set for a ten second count. This gave a frequency resolution of 2×10^{-9} for the 5 mc crystals and 1×10^{-9} for the 10 mc crystals. Both of these crystals indicated a constant aging rate over the test period. E.E.B.

N65-27907# Advanced Technology Corp., Timonium, Md.
HIGH POWER FERRITE PHASE SHIFTER Semiannual Technical Report
Frederick L. Wentworth 15 Jan. 1965 69 p refs
(Contract AF 30(602)-3495); ARPA Order 550)
(AD-610467)

Theoretical and experimental investigations of the microwave properties of ferrites at magnetic fields above ferromagnetic resonance are described. The program goal is the development of high power reciprocal phase shifters for X-band and C-band operation. The principal objective is to demonstrate that ferro-magnetic losses do not increase with the application of high RF power as typically observed for operations at magnetic fields below resonance. Insertion losses are given as a function of magnetic field strength for samples of nickel-zinc-ferrite, manganese-magnesium ferrite and yttrium-iron garnet in a longitudinally magnetized rod configuration. A second absorption peak on the high side of resonance was observed and is identified as a body resonance. The data demonstrates that, at a fixed frequency, the second peak moves toward the ferromagnetic resonance peak as the cross sectional dimensions are reduced. Author

N65-27914# Atomics International, Canoga Park, Calif.
COMPARISON OF NEUTRON AND GAMMA RADIATION DAMAGE IN SEMICONDUCTORS
M. N. Robinson 10 Jun. 1965 16 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10856) CFSTI: $1.00

Calculations are presented which relate the damages produced in silicon semiconductors by SNAP (Systems for Nuclear

Auxiliary Power) reactor neutrons and gammas. Design dose levels are derived for SNAP payload components, consistent both with this relation and with the necessity of minimizing shield weight. Author

N65-27916# India. Dept. of Atomic Energy, Bombay.
ACCELERATED LIFE-TEST OF BEL SEMICONDUCTORS
A. Krzycki (Inst. Baden Jadrowych) 10 Dec. 1964 13 p refs
(AEET/ED/SG/23)

The behavior of six types of semiconductors was observed during an oven storage test at 75° C over a period of 1850 hours. Two diodes and four germanium transistors were tested. Measurements of collector leakage current and current gain were made, since they are usually of greatest importance in circuit design, and since they also show the greatest variability with time. The results show that the decrease in current gain and increase of leakage current may be depicted by a straight line plot on the logarithm time scale. It was also found that the transistors from one particular manufacturer were superior to those from another. J.M.D.

N65-27925# SFD Labs., Inc., Union, N. J.
DEVELOPMENT OF AN X-BAND CW CROSSED-FIELD AMPLIFIER Sixth Interim Development Report, 1 Oct.–31 Dec. 1964
G. K. Farney and J. Hentschel Jan. 1965 37 p ref
(Contract NObsr-89503)
(SFD-33-IDR-6; AD-610412)

Effects of radiation and the cumulative random errors have been detrimental factors influencing the match to the new slow wave circuits under investigation. The radiation problems have been minimized by the use of shielded transmission lines as the means of coupling. An analysis of small random errors resulted in the construction of a higher voltage circuit having only 60 sections. This circuit has been matched and should be hot tested in mid-January 1965. Author

N65-27929# Sylvania Electric Products, Inc., Mountain View, Calif. West Electronic Defense Labs.
COMPACT TUNABLE FILTERS
R. Wilds, G. Wheeler, and E. Cota [1965] 8 p ref
(Contract DA-36-039-AMC-00088(E))
(AD-610397)

This paper describes a compact, double-cavity preselector filter. The filter is tunable from one to two Gc, has a bandwidth of 15 Mc, and has a 1.5 db insertion loss at resonance. Other similar units at S-band are also described. Mechanical as well as electrical details are presented. Author

N65-27934# American Electronic Labs., Colmar, Pa.
DESIGN AND DEVELOPMENT OF SEMICONDUCTOR TEST SET, AN/USM-171 Fifth Quarterly Report, 1 Jul.–30 Sep. 1964
W. R. Orloff, P. M. Kurland, T. B. Stavely, and T. J. Ryan [1964] 31 p
(Contract DA-36-039-AMC-03242(E))
(Rept.-5; AD-610789)

Progress on the development of the emitter finder stop-test circuit and fault finder in the automatic lead selector is reported. Verification tests were made on the measurement circuits, and mechanical packaging of the basic structure was accomplished. The semiconductor test set AN/USM-171 is described, and the stop test block diagram and emitter finder memory circuitry are given. E.E.B.

N65-27964# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
FIRST TEST ON RADIATION EXPERIMENTATION FOR THE Q-FACTOR TECHNIQUE Final Report, 1 Oct. 1963–30 Sep. 1964
B. E. Curtsinger and A. R. Robinson Kirtland AFB, N. Mex., AF Weapons Lab., Feb. 1965 56 p refs
(Contract AF 29(601)-6213)
(FZK-207; WL-TR-64-146; AD-614112)

Seventy-six transistors were irradiated. The transistors were irradiated under closely controlled environmental conditions and bias levels. Data were taken on the transistors during irradiation and during periods of reactor shutdown. Ten 2N914, twenty 2N709, and forty-nine 2N1613 transistors were irradiated. This report contains discussions of test technique, description of the test, and dosimetry results. Author

N65-27970# Chalmers Univ. of Technology, Goteborg (Sweden). Research Lab. of Electronics.
SOME FREQUENCY AND POWER CONVERSION PROPERTIES OF CYCLOTRON WAVES Technical Note No. 5
Olle Nilsson 1 Jan. 1965 35 p refs *Its* Res. Rept.-50
(Contract AF 61(052)-594)
(RADC-TR-65-155; AD-614123)

In this report Adler tube type devices are considered. Fast cyclotron waves at one or several discrete frequencies are excited on the electron beam by the use of a Cuccia coupler. The modulated beam is shot through a 2n-pole where, contrary to the usual pumping procedure, power is extracted from the cyclotron waves. An analysis of the frequency and power conversion properties of a cyclotron wave excited 2n-pole is carried out. An experiment was made where an electron beam, carrying fast cyclotron waves of frequencies f_1 and f_2 at the power levels P_{f_1} and P_{f_2} respectively, was shot through a quadrupole. In accord with the theoretical findings the quadrupole output power was of the frequencies $2f_1$, f_1+f_2 and $2f_2$ with the respective power levels proportional to $P^2_{f_1}$, $P_{f_1} \cdot P_{f_2}$ and $P^2_{f_2}$ over a wide dynamic range. Finally an Adler tube with two quadrupoles between the input and output Cuccia couplers is considered. One of the quadrupoles extracts a fraction of the signal power at twice the signal frequency and serves as the source of the pump voltage which is fed to the other quadrupole via an external amplifier. Thus the pump voltage is phase locked to the signal. The properties of the basic types of this amplifier are discussed. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-26687 Centre Electronique Horloger, S. A., Neuchâtel (Switzerland).
REVIEW AND DISCUSSION OF THE NEW TECHNIQUES FOR MICROELECTRONICS [REVUE ET DISCUSSION DES TECHNIQUES NOUVELLES POUR L'ELECTRONIQUE MICROMINIATURISSEE]
Kurt Hübner *In* Soc. Suissee de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 403–420 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

Microelectronics is but a new tool offering the systems designer solutions hitherto impossible. There are already several excellent review papers describing these new techniques

and it is only by introducing an element of judgement, without impairing objectivity, that we consider justified our contribution. This judgement we feel is necessary, as microelectronics, like most new technologies also has its disadvantages. The first objectives are review and discussion of established techniques like circuits of individual miniaturized components, monolythic and thin film circuits. With this basic information we examine reliability, performance, price, volume and weight, as well as the special aspects of chronometry. Two current techniques to produce microcircuits are then described in detail by following their fabrication procedure step by step. A review of elements and techniques still under development concludes our paper. Author

N65-26688 Centre Electronique Horloger, S. A., Neuchâtel (Switzerland).
ELECTRONICS AND HOROLOGY [L'ELECTRONIQUE ET L'HORLOGERIE]
Roger Wellinger *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 421–427 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

The review of the development of electronics and horology brings out their similitudes as well as their fundamental differences. Throughout its development electronics has steadily increased its capacity to transmit more information. The number of bits transmitted per second or the bandwidth of its equipment gives the order of magnitude characterizing its growth. The growth of horology follows an opposite course since its purpose is to increase the stability of oscillators whichever their nature may be. The major objective is in fact to reduce the bandwidth of its instruments. In horology it is also interesting to follow the influence which new discoveries in the field of electronics exert upon time-measuring methods. From the point of view of bandwidth our two branches are at opposite poles. However the newly discovered techniques of microminiaturisation may be used equally well in both fields, since they are well within watchmaking dimensions. The conclusion brings out the necessity to review the general theory underlying electronics if one wants to apply it successfully to the field of horology. Author

N65-26970# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
ON NONLINEAR OPTIMAL CONTROL PROBLEMS WITH CONTROL APPEARING LINEARLY
Herman Munich (Ph.D. Thesis, Adelphi Univ.) Jun. 1965 81 p refs
(Contract AF 49(638)-1207)

This report considers the problem of finding the thrust program so that a specified payload is delivered in vertical flight to a desired altitude with least fuel expenditure and other control problems. Pontryagin's maximum principle is the primary tool employed. For the control problems considered, the control appears linearly in the system of equations. The problem of finding the thrust program so that a specific payload is delivered in vertical flight to a desired altitude with least fuel expenditure is considered for a wide class of drags. It is shown that under proper conditions there are at most three S-subarcs. An example is given to a drag coefficient that leads to four or five T-subarcs controls. For the other problems considered, the control appears in only one of the equations describing the system, and it appears linearly. These are called canonical systems. Under proper conditions, it is shown that for such canonical systems the optimal control assumes only boundary points and, in addition, has at most one point of discontinuity. This analysis of canonical systems provides a new result for the minimum time operation of a batch reactor. N.E.A.

N65-27095 Cornell Univ., Ithaca, N. Y. School of Electrical Engineering.
INVESTIGATION OF LINEAR BEAM AND NEW CONCEPTS OF MICROWAVE POWER. VOLUME I: GENERAL REPORT AND BASIC BEAM PHENOMENA Fourth Quarterly Progress Report, 1 Jul.–30 Sep. 1964
B. K. Andal, T. G. Mihran et al Griffiss AFB, N. Y., RADC, Apr. 1965 272 p refs
(Contract AF 30(602)-3243)
(RADC-TR-64-563, Vol. 1; AD-615961)

This report presents the results of some basic studies on magnetically focused electron beams. These include experimental and theoretical studies of space–charge wave propagation along an electron beam with a periodically varying diameter; an experimental study of noise growth in scalloped and nonscalloping Brillouin electron beams; theoretical and preliminary experimental studies of the conditions that must be met to obtain a nonscalloping immersed electron beam; and theoretical and experimental studies of the growth of peak beam velocity, beam noise, and signals in electron beams. These studies have revealed phenomena that are characteristic of very well-controlled electron beams. Author

N65-27096# Cornell Univ., Ithaca, N. Y. Electrical Engineering Research Lab.
INVESTIGATION OF LINEAR BEAM AND NEW CONCEPTS OF MICROWAVE POWER. VOLUME II: BEAM–CIRCUIT ACTION
S. C. Wang and J. Walder Griffiss AFB, N. Y., RADC, Apr. 1965 177 p refs
(Contract AF 30(602)-3243)
(RADC-TR-64-543, Vol. II; AD-615939)

The report describes a method to improve both the gain and efficiency of conventional klystrons by varying the beam impedance through the change of d-c beam voltage at appropriate locations along the beam. Results are given in both small- and large-signal analyses for two- and three-cavity klystrons with gridded- and gridless-gap resonators. Analytical expressions of beam-loading conductance for a transformed beam interacting with both gridded- and gridless-gap resonators are derived. From small-signal theory the efficiency was found to be directly proportional to M^2/G'_{BL} and the gain to $(m_b M^2/G'_{BL}$ (where M is the beam-coupling coefficient, G'_{BL} is the beam-loading conductance, and m_b is ratio of transformed beam velocity to original beam velocity). This is valid in the large-signal domain, provided that M and G'_{BL} are a-c voltage independent. The large-signal efficiency was found to be dependent on a-c velocity spread only after the transit angle of the output gap decreased to a certain limit. The best location for putting bias was found to be the point of a-c velocity minimum. Author

N65-27097# Cornell Univ., Ithaca, N. Y. Electrical Engineering Research Lab.
INVESTIGATION OF LINEAR BEAM AND NEW CONCEPTS OF MICROWAVE POWER. VOLUME IV: NANOSECOND PULSE STUDY
F. Einaudi Griffiss AFB, N. Y., RADC, Apr. 1965 124 p refs
(Contract AF 30(602)-3243)
(RADC-TR-64-563, Vol. IV; AD-615963)

A theory based on an idealized model and including space charge explicitly is developed for the nonlinear behavior of an electron beam velocity-modulated by an ideal gap and of finite cross section filling a conducting cylinder. A strong axial magnetic field allows the motion of electrons in the axial direction only. An expression for the current density has been derived using a method of successive approximations. Starting from

the known solution for the infinite beam, successive approximations have been considered to take account of the finite radius of the beam. The axial component of the electric field as a function of r and z has been evaluated. Author

N65-27183# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
A TOPOLOGICAL FORMULATION OF THE N-PORT PROBLEM AND THE SYNTHESIS OF A CLASS OF SINGULAR IMPEDANCE MATRICES
Charles L. Suffel Jun. 1965 42 p refs Submitted for Publication
(Contract AF 49(638)-1402)
(PIBMRI-1269-65; AD-615576)

This paper is in two parts. First, a rigorous, topological treatment is applied to the resistive n-port problem. Formulas are derived for the open-circuit impedance and short-circuit admittance matrices. Properties of these formulas are used to establish sufficient conditions for the realization of the matrices as well as relationship between the network geometry and the ranks of the matrices. Secondly, Nambier's results are generalized to the case of an n-port with connected port structure. Author

N65-27189# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Applied Mathematics Research Lab.
SECOND ORDER PROPERTIES OF NONLINEAR SYSTEMS DRIVEN BY RANDOM NOISE
Lynn E. Wolaver Apr. 1965 198 p refs
(ARL-65-61; AD-615821)

The general objective of this study is to develop methods for finding the autocorrelation or spectral density of the output of certain second order nonlinear systems which are driven by white Gaussian random noise n(t). Four distinct and separate methods are employed. These are divided into the areas of analytical methods, numerical techniques, approximation and linearizing techniques, and the experimental methods of direct simulation. Author

N65-27245 Joint Publications Research Service, Washington, D. C.
LOGICAL CIRCUITS WITH TERNARY PARAMETRONS
V. P. Komolov and A. S. Roshal *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 230–238 refs (See N65-27225 16-34) CFSTI: $6.00

Circuits are proposed with parametrons which perform ternary logical functions for digital devices with a phase recording of information. A modified majority circuit has been proposed as the basis of these circuits, which form a complete system of ternary logical functions. The results of experimental investigation of such circuits are given. Author

N65-27251 Joint Publications Research Service, Washington, D. C.
ON THE CONNECTION BETWEEN THE GEOMETRICAL AND PHYSICAL DESCRIPTIONS OF ELECTROMAGNETIC BEAMS IN QUASI-OPTICAL SYSTEMS
S. N. Vlasov and V. I. Talanov *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 260–264 refs (See N65-27225 16-34) CFSTI: $6.00

Presented is a method which combines the use of the wave and geometric approach for examining an arbitrary axially symmetric wave guide formed by periodically disposed groups of undiaphragmed quadratic phase transformers (lenses) placed in a medium with a wave number $k = 2\pi/\lambda$. Also considered in the analysis are multibeam oscillations in quasi-optical resonators. The method can be generalized for electromagnetic beams in heterogeneous mediums, when the dimensions of the heterogeneities of the dielectric (d) so much exceed the wave length λ that a size of the beam (a) can be indicated which satisfies the condition $d >> a >> \lambda$. S.C.W.

N65-27254 Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF AUTOMATIC CONTROL SYSTEMS BY MEANS OF AMPLITUDE-PHASE CRITERIA OF THE NECESSARY STABILITY IN MODULUS AND PHASE
A. S. Klyuyev *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 275–279 refs (See N65-27225 16-34) CFSTI: $6.00

A method is proposed for determining the reserve of stability of a system on the plane of a complex variable, by the position of the amplitude-phase characteristic of the open automatic system in relation to two points from which the necessary stability modulus and stability in phase can be calculated. Presented are results of determinations in the plane of the parameters of adjustment of the proportional-integral regulator, and the proportional-integral-differential regulator. The proposed amplitude-phase criteria can also be used to determine regions of required stability and its parameters which assure stability under optimum conditions of automatic control. S.C.W.

N65-27255 Joint Publications Research Service, Washington, D. C.
THE ABSOLUTE STABILITY OF CERTAIN CLASSES OF CONTROL SYSTEMS
V. A. Brusin *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 280–282 *ref* (See N65-27225 16-34) CFSTI: $6.00

Presented is an analysis of two combinations of control systems having the properties $\alpha_0-\alpha_0$ and $\alpha^0-\gamma^0$, which are a generalization of properties in α^0, α_0. Based on the assumption that class $\alpha_0-\gamma_0$ or class $\alpha^0-\gamma^0$ systems are absolutely stable if for any output y(t) of that class corresponding to the input u(t), such that $|u| < \infty$, $|\dot{u}| < \infty$, $\int_0^\infty |u(s)|\,ds < \infty$, the condition $y(t) \to 0$ is valid at $t \to \infty$; two theorems are derived for determining the absolute stability of both classes of control systems. S.C.W.

N65-27298*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CONTROL THEORY HANDBOOK
Doyle Garner 22 Apr. 1964 187 p refs
(NASA-TM-X-53036) CFSTI: HC $5.00/MF $1.25 CSCL 20C

The equations of motion and the basic control theory applicable to stability and response analyses for a flexible launch vehicle using a unified coordinate system and notation are presented. The flight system coordinates and notations are shown and the rigid body equations are derived for the pitch and yaw planes. A conventional control system is introduced which contains a position gyro, rate gyro, accelerometer and angle-of-attack meter. The gains of the control mechanism and the vehicle parameters are related to the frequency and damping of the rigid body. The construction of a synthetic wind profile for control system studies using the 95 or 99 percent probability of occurrence wind speed profile and the 99 percent probability of occurrence wind shear envelope is discussed and illustrated, and the method for superimposing a gust on the synthetic wind profile is shown. Routh's stability criterion, Hurwitz' stability criterion, root locus, frequency response

methods, and Nyquist criterion are discussed and applied to a vehicle containing one bending mode, a control filter, and an actuator. R.N.A.

N65-27304# Harvard Univ., Cambridge, Mass. Cruft Lab.
OPTIMIZATION OF THE YAGI ARRAY, I Scientific Report No. 6 (Series 3)
I. Larry Morris 15 Oct. 1964 69 p refs
(Contract AF 19(628)-2406; Grant NSF GP-851)
(AFCRL-65-121; AD-615742)

The generalized integral equations for the curtain array are presented so that element length, spacing and radius may vary. The quasi-zero-order theory as originally applied to circular arrays and later extended to include curtain arrays is reviewed. The separation principle which is employed to simplify the integral equations is discussed in detail. A modified quasi-zero-order theory which incorporates approximations to the integrals that are independent of element length and spacing is introduced. Six simple configurations are presented which compare the solutions and the residuals of the vector potential resulting from the original and modified quasi-zero-order theories. A number of single antennas and parasitic couplets for which there is experimental data, is compared with the modified theory. Currents, residuals, and radiation patterns are presented for 4- and 10-element Yagi arrays. Author

N65-27313# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.
DESIGN OF NARROW-BAND, DIRECT-COUPLED WAVEGUIDE FILTERS USING TRIPLE-POST INDUCTIVE OBSTACLES
E. A. Mariani Mar. 1965 27 p refs
(COM-2566; AD-614980)

The theory and design of triple-post inductive obstacles are presented for the purpose of achieving direct-coupled, narrow-pass-band waveguide filters. A design procedure is discussed which permits the accurate design of filters with bandwidths of less than one percent. This type of filter construction is both mechanically simple and rugged without any sacrifice of electrical performance. Author

N65-27321# Litton Industries, San Carlos, Calif. Research Lab.
RESEARCH ON NOISE IN CROSSED-FIELD GUNS Quarterly Report, 1 Jan.–31 Mar. 1965
R. P. Wadhwa 20 Apr. 1965 28 p refs
(Contract NObsr-89546)
(QR-7; AD-615556)

Additional measurements on the dependence of noise figure upon the various operating parameters are described. Noise measurements in the complete frequency band and reduction of noise figure by stub tuning at the output terminal of the tube are discussed. Data from the reflected power seems to indicate that there is a slight shift in frequency between hot and cold test VSWR measurements. The correlation between noise figure and VSWR measurements is discussed. Some Kino gun features are investigated experimentally by operating the tube at different values of the magnetic field; other parameters are changed accordingly. This requires then a velocity jump at the gun exit so that the electrons drift at the synchronous velocity in the interaction region. Author

N65-27339# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrical Engineering.
OPTIMAL CONTROL SENSITIVITY DESIGN
A. Kestenbaum Jun. 1965 34 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1266-65; AD-615546)

The problem dealt with in this study consists of minimizing an integral of the form

$$S = \int_0^T F(x, u)dt$$

The output x(t) and input u(t) are related by a differential equation of the form

$$x = f(x, u, w)$$

where w is the plant parameter which is unspecified except for range of variations. An optimum structure for the controller is obtained and a game theory approach is used to select a controller parameter which minimizes the maximum value of S when the plant parameter is subject to the above uncertainty. Author

N65-27463# Montana State Coll., Bozeman. Dept. of Electrical Engineering.
OPTIMAL CONTROL OF DISTRIBUTED-PARAMETER SYSTEMS: THE STATE OF THE ART
R. C. Kolb and D. A. Pierre [1964] 32 p refs Presented at the IEEE Reg. 6 Conf., Salt Lake City, Apr. 1964
(Grant NSF GP-1440)

The general problem considered in this paper is that of minimizing some functional criteria, such as the integral-square-error criteria, of a system governed by partial differential equations. The equations contain control variables, forcing functions, which have limited range of action, and are subject to certain initial and boundary conditions. The authors present an extensive review of the literature which pertains to the solution of such problems. Detailed explanations are given of the general, but abstract, theories which have been advanced recently by Butkovskii and Lerner in Russia and by Wang and Tung in the USA. The design techniques of Butkovskii and Lerner involve the use of Pontryagin's maximum principle while those of Wang and Tung illustrate the dynamic programming viewpoint. By applying all of the available techniques to one practical control problem, the authors are able to compare the techniques and to point out present limitations. Author

N65-27658# Illinois Univ., Urbana. Coordinated Science Lab.
ON MINIMAL-VARIANCE CONTROL OF LINEAR SYSTEM WITH QUADRATIC LOSS
Michael K. Sain Jan. 1965 51 p refs
(Contract DA-28-043-AMC-00073(E))
(R-240; AD-610776)

The problem of minimizing the variance of a quadratic performance index, in the presence of control noise whose properties are known *a priori*, has been studied for linear, constant systems with open-loop control. The expected value of the performance index is constrained to be a positive number, which cannot be less than the optimal mean index when variance is free. Solution is by means of the calculus of variations, which is applied to an equivalent noise-free problem. The necessary (Euler) equations are integro-differential and have a kernel matrix derived from output correlation functions. A maximum estimate for the number of eigenvalues is given, and is refined for the special case of single-input, state-output control. Necessary and sufficient conditions for a unique solution can be found in specific examples. Author

N65-27673# California Univ., Livermore. Lawrence Radiation Lab.
SECTORIAL PARALLEL PLATE TRANSMISSION LINE
Robert E. Kelly Sep. 1964 31 p refs
(Contract W-7405-ENG-48)
(UCRL-14141) CFSTI: $2.00

Differential equations for voltage and current are derived for a nonuniform transmission line and are used to solve the problem of a sectorial shaped line composed of two parallel plates separated by a dielectric of constant thickness. The complex power is calculated and used to gain information regarding energy propagation for various conditions. The characteristic impedance is found to be complex in general and dependent upon distance along the line, therefore serving as a continuous impedance transformer which would be quite useful for pulses. These results, using the transmission line equations for voltage and current, are shown to be consistent with the electric and magnetic fields derived from Maxwell's equations. The problem of a uniform rectangular parallel plate transmission line is also analyzed. Author

N65-27696# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
OPTIMIZING THE ASSIGNMENT PROBLEM IN THE SYNTHESIS OF SEQUENTIAL MACHINES
Jesse Warren Halsey (M.S. Thesis) Aug. 1964 101 p refs
(GRE/Math/64-15; AD-610771)

A procedure for assigning binary codes to the inputs of a sequential machine is examined in an attempt to mechanize the procedure using linear programming. Reasons are given for the difficulty involved in attempting to derive linear constraining equations for an objective function specified by the procedure. The partition-pair on the set of states of a sequential machine is extended to the inputs of a sequential machine in an effort to simplify the logical equations. It is shown that input-state pairs are effective in obtaining the simplification of these logical equations. Author

N65-27739*# Bunker-Ramo Corp., Canoga Park, Calif.
MODERN CONTROL SYSTEM THEORY AND HUMAN CONTROL FUNCTIONS
R. W. Obermayer and F. A. Muckler Jul. 1965 48 p refs
(Contract NASw-869)
(NASA-CR-256) CFSTI: HC $2.00/MF $0.50 CSCL 06D

Within the framework of current modern optimal control theory, the approaches of Pontryagin, Bellman, and Kalman are presented. Expansions to cover the case of adaptive control are examined. A number of problems in applying the formal mathematical models are noted, including difficulties in defining the physical problem, computational requirements, introduction of feedback control, and proper selection of the performance index. The problem of the application of modern control theory to the case of manual control systems is considered. L.S.

N65-27846# Polytechnic Inst. of Brooklyn, N. Y.
TWO THEOREMS ON POSITIVE-REAL FUNCTIONS AND THEIR APPLICATION TO THE SYNTHESIS OF SYMMETRIC AND ANTIMETRIC FILTERS
D. C. Youla Griffiss AFB, N. Y., RADC, Apr. 1965 47 p refs
(Contract AF 30(602)-2868; Grant AF-AFOSR-62-280)
(PIBMRI-1252-65; RADC-TR-65-86; AD-616266)

It is shown that the power gain of a filter which has been partitioned into two component parts may be expressed in terms of a formula involving only the two impedances seen looking to the left and the right of the common junction. By imposing the constraints of symmetry and antimetry this formula leads to two global equations for positive-real functions. Theorems 1 and 2 present necessary and sufficient conditions for the existence of solutions. Moreover, the construction of these p.r. functions is made to depend on two algorithms of an extremely simple character. The theory is fully illustrated by means of four worked, non-trivial examples. Finally, it is pointed out that synthesis by bi-section is often wasteful of reactances (especially in the symmetric case) and a careful count of elements is presented for antimetric filters. Author

N65-27864# Columbia Univ., New York. Statistical Engineering Group.
MARKOVIAN SEQUENTIAL CONTROL PROCESSES–DENUMERABLE STATE SPACE
Cyrus Derman 1 Aug. 1964 19 p refs
(Contract Nonr-266(55))
(TR-23; AD-444046)

A dynamic system is treated which is observed periodically and classified into one of a number of states. After each observation one of a possible number of decisions is made. The decisions determine the change laws of the system. The number of possible states is infinite. If $\{Y_t\}$, $t = 0, 1, \ldots$, denotes the sequence of states and $\{\Delta_t\}$, $t = 0, 1, \ldots$, denotes the sequence of decisions, the process $\{Y_t, \Delta_t\}$ is termed a Markovian sequential control process. Rules for sequentially controlling the process, i.e. procedures specifying the decision to be made at each point in time as a function of the history of the system, are analyzed. MARDA

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-26881* Rocketdyne, Canoga Park, Calif.
A HIGH-TEMPERATURE CIRCULAR-APERTURE BLACKBODY RADIATION SOURCE
P. E. Schumacher *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 233-240 refs (See N65-26855 16-33)
(Contract AF 19(604)-8066) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 14B

A one-quarter inch diameter, circular aperture blackbody radiation source is described. The unit, designed for the field calibration of missile- and air-borne radiometers, is self-contained with the exception of an electrical power source. It is usable in this configuration to temperatures of 2300° C. The radiation source, which is windowless and, therefore, usable over a broad spectral range, has a short time constant associated with temperature changes, namely, about 1 minute. The source consists of two principal components: an electrically heated blackbody with attached power transformer and a power control—cooling system console. These components are interconnected by hoses and electrical cables to afford flexibility in the placement of the blackbody. The performance of the system with respect to temperature stability and uniformity is discussed, and the theoretical determination of the effective source emissivity of 0.98 is reviewed briefly. With increased electrical power handling capabilities and cooling system capacity, temperatures of 2800° C have been reached. Author

N65-26932# RAND Corp., Santa Monica, Calif.
A MATHEMATICAL MODEL OF SUPPLY SUPPORT FOR SPACE OPERATIONS
Raoul J. Freeman, David C. Gogerty, Glenn W. Graves, and Robin B. S. Brooks Apr. 1965 28 p ref
(Contract AF 49(638)-700; Proj. RAND)
(RM-4520-PR; AD-615165)

The development of a method to evaluate various aspects of logistics supply support of space bases is presented. The scheduling model can be used in two different modes: as part of a control system for an actual space base, or as a planning tool to aid in the design of a space base and the formulation of operations schedules. The mathematical formulation of this scheduling problem is a simple, nonlinear, discrete programing problem. An algorithm was developed for its solution, and is described. The operation of the model is illustrated by showing how it would supply a lunar base over a period of two years. First, a detailed schedule of operations was derived and translated into requirements during the two-year period. Number, dates, and cargoes of specific trips were then calculated. The sequence of trips and their associated cargoes represented a feasible mode of supporting the operation and development of the lunar base with its given set of scientific missions. R.R.D.

N65-27138 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A CHAMBER SIMULATING THE CONDITIONS OF MARS FOR MICROBIOLOGICAL RESEARCH
A. I. Zhukova and I. I. Kondrat'yev *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 251–258 refs (See N65-27125 16-13)

A chamber that simulates the conditions of Mars for microbiological research is described and its electrical circuitry indicated. Orientation experiments in which fungus and bacterial cultures were exposed under these conditions are cited. Author

N65-27154# Aerospace Medical Div. Aerospace Medical Research Labs. (6570), Wright-Patterson AFB, Ohio. Biomedical Lab.
EXPERIMENTAL DETERMINATION OF THE MAXIMUM SAFE THERMAL RADIATION LOADS FOR A FIGHTER-BOMBER COCKPIT Final Report, Mar. 1961–Jan. 1962
Hubert T. Davis and William C. Kaufman Dec. 1964 43 p refs
(AMRL-TR-64-139; AD-615812)

The maximum thermal radiation load to which the cockpit of a fighter-bomber may be safely subjected was determined experimentally. Fighter-bombers delivering nuclear weapons under cloud conditions may encounter these thermal radiation loads. A static F-100C cockpit was the test vehicle and four human subjects dressed in full flying equipment were exposed in it to thermal pulses simulating those of nuclear detonations. An unprotected cockpit and pilot can be safely subjected to a range from 3 to 5 cal/cm^2 if the yield of the weapon is approximately one megaton. This limit assumes adequate protection for the pilot's eyes. Materials in an unoccupied, unprotected cockpit will smoke profusely and char (but not flame) under a load of approximately 10 cal/cm^2. Partial cracks will form in the plexiglass canopy under an absorbed load of approximately 11 cal/cm^2. Author

N65-27166# Naval Research Lab., Washington, D. C. Metallurgy Div.
THE DESIGN, CONSTRUCTION, AND EQUIPMENT OF A NEW HIGH LEVEL RADIATION LABORATORY AT NRL
E. J. Chapin 14 Apr. 1965 122 p
(NRL-6205; AD-615369) CFSTI: $2.75

A new NRL High Level Radiation Laboratory is described, with special emphasis on the design, construction, and collateral equipment. This laboratory provides a means for safely handling and conducting research on gamma-active materials of interest to the Navy. The facility includes: five hot cells, with three designed for 1,000 curies and two designed for 10,000 curies of 1-Mev gamma; isolation cubicles back of cells; a "warm" work area; a decontamination room; X-ray laboratory; radiochemistry laboratory; machine shop; isotope storage facilities; waste disposal system; "cold" laboratories; and offices and utilities area. Design innovations discussed include: steel-lined cells; all-glass windows with exceptional viewing angle and clarity; manually operated hinged steel shielding doors; internal and external transfer drawers; special receptacle panels in cells; cell lighting; underwall U-tubes; under-window access ports; removable roof plugs; isotope storage; waste disposal system; and gas scrubber. Equipment discussed includes: heavy-duty master–slave manipulators; mechanical arm manipulators and bridge cranes in cells; through-the-wall periscope; through-the-wall stereomicroscope; a remotely controlled shielded metallograph with through-the-wall specimen transporter; and metallographic specimen preparation equipment. Results of tests with a 9,500-curie Co-60 source on the shielding integrity of the facility are presented. Author

N65-27199# Dresser-Ideco Co., Columbus, Ohio.
TOWER FOR MULTIPLATE ANTENNA Final Engineering Report
John K. Groseclose Apr. 1965 31 p refs
(Contract AF 19(628)-2977)
(AFCRL-65-341; AD-615784)

This report describes the response of a 1000-foot guyed television tower to the environmental influences of wind and temperature. It compares the response data with data previously collected. The report includes a description of the apparatus and techniques used to record the data. Author

N65-27296*# Minnesota Univ., Minneapolis. School of Public Health.
THE BACTERIOLOGY OF "CLEAN ROOMS" Progress Report, 1 Oct. 1964–31 Mar. 1965
G. S. Michaelsen [1965] 13 p
(Grant NsG-643)
(NASA-CR-63470) CFSTI: HC $1.00/MF $0.50 CSCL 06M

Routine bacteriological ambient air, bench top surface, and stainless steel strip contamination sampling was carried out on 8 occasions in each of four rooms representing different ranges of environmental control and personnel practices in regard to cleanliness. The routine air and bench top sampling was carried out with agar contact plates and subsequent morphological study of all bacterial colonies on the plates. Only colonies developing from heat shock aliquots were selected from stainless steel strips for identification procedures. The quantitative data from air and bench top sampling in all four rooms reflect the differences in control measures. The room with the greatest control yielded the lowest mean colony counts. Stainless steel strips showed no marked contamination build-up over a prolonged period of time, even for heat resistant organisms. The great majority of contaminants in all rooms were of human origin with a relative constant percentage of "spore forming" bacteria among all four rooms. G.G.

N65-27310# Arctic Health Research Center, Anchorage, Alaska.
OBSERVATIONS ON A SEWAGE OXIDATION POND IN SOUTHCENTRAL ALASKA
D. K. Hilliard Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Jan. 1965 24 p refs
(AAL-TDR-64-17; AD-614996)

Observations were made on a sewage pond during the period May through December of 1963. The water chemistry of this facility indicated that during the period of maximum photosynthetic activity (May through August), ammonium compounds and phosphate phosphorus appeared to be readily utilized by the algae, but during the colder months these compounds built up significantly. Similarly, the biological oxygen demand (BOD) was generally low during the warmer months (30 mg/l or less) but increased appreciably with the advent of ice cover. The pH and dissolved oxygen content both indicate a photosynthetically healthy regime during the warmer months, but the the latter parameter became depressed with occurrence of ice. During the course of this investigation, pond odor was not detectable until after ice cover had formed. Matting occurred only once but disappeared within a short time. Plankton analyses indicated 18 taxa of photosynthetically active algae, belonging principally to Chlorococcales and Volvocales. Of the last named order, 11 species are new for North America and presumably are new records as sewage-tolerant organisms. The Alaskan pond was compared with an experimental pond receiving comparable BOD loading at Fayette, Missouri, and the results are discussed. Author

N65-27324# Mitre Corp., Bedford, Mass.
INTERSYSTEM INTEGRATION ASPECTS OF THE AIR FORCE SYSTEM ACQUISITION PROCESS FOR ELECTRONIC SYSTEMS
R. C. Grandy and J. Nicholls Apr. 1965 89 p refs
(Contract AF 19(628)-2390)
(ESD-TR-65-108; TM-04158)

This report discusses the implicit intersystem integration aspects of the current DOD and Air Force systems management doctrine as it applies to the acquisition of large scale electronic systems. The normative flow of the acquisition process, abstracted from Air Force and Air Force Systems Command regulations and manuals in the 375 series, is described. Important intersystem integration activities and events are then identified and associated with this basic process as a means of establishing a foundation for the proper consideration of intersystem relationships during the planning, design and development of large electronic systems. Proposed formats for the preparation of specific documentation that can be used to record the intersystem requirements for inclusion in the primary system documentation are provided in the Exhibits at the end of the report. Author

N65-27329# Space/Defense Corp., Birmingham, Mich.
ENGINEERING FEASIBILITY STUDY FOR THE ARTICULATING CENTRIFUGE CONCEPT Final Report, Jun.–Oct. 1964
Michael Brian Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 175 p refs
(Contract AF 33(615)-1893)
(AMRL-TR-64-138)

There are two distinct G-time ranges of accelerative study under examination at the present time. These are currently being conducted by use of the conventional centrifuge and the impact machine. A wide area exists, in terms of the duration of the acceleration, between the two types where investigation has stagnated for lack of equipment capable of operating in this particular regime. The articulating centrifuge concept is intended as an economic means of enabling investigations to be conducted in a portion of this, hitherto, little known area. The report introduces a unique concept for a device capable of generating a variety of G-time profiles and utilizing present state-of-the-art techniques and commercially available components. The physical appearance of the design concept is dealt with initially and a determination made of the most suitable configuration. An examination of the structural weight and stresses developed is included to indicate feasibility. This includes comparison of requirements for a 15-, 50-, or 150-pound payload with the rationale for selection of the 50-pound option with a 12-foot radius of rotation for more intensive study. Following this, the dynamics of operation are analyzed and the various characteristics examined. Coriolis forces generated are reasonably small and can be considered a minor perturbation on the overall G-time exposure curve. The operating mechanisms controlling the centrifuge are described in appropriate detail and critical features noted. Auxiliary and ancillary equipment are also discussed as well as the basic building requirements for housing the centrifuge. Finally, a set of design specifications is included, based on information furnished in the body of the report. Author

N65-27360 European Organization for Nuclear Research, Geneva (Switzerland).
A NEW FOCUSING SYSTEM CONSIDERABLY INCREASING THE ACTUAL PS-NEUTRINO BEAM FLUX DENSITY
A. Asner and Ch. Iselin 17 May 1965 49 p
(CERN-65-17)

Two variants of a new focusing system are described which will both yield a considerable higher neutrino flux density than the actual layout with the magnetic horn. The final retained and proposed variant consists of the actual 300 KA-magnetic horn with a long 45 cm Cu target, and a V-shaped 400 KA reflector R at maximum 5 m long, placed at 14.5 m from the origin of the focusing system. The neutrino computation results for the recent Brookhaven proposal, the "Magnetic fingers", are also discussed. N.E.A.

N65-27376*# RCA Service Co., Inc., Camden, N. J. Nuclear and Scientific Services Dept.
A LARGE ULTRA HIGH VACUUM ENVIRONMENTAL CHAMBER WITH LIQUID HELIUM COOLED WALLS
C. D. Elderkin and J. M. Bradford (NASA, Langley Field, Va.) [1965] 21 p Presented at Inst. of Environ. Sci. Tech. Meeting and Equipment Exposition, 21–23 Apr. 1965
(Contract NAS1-1918(c))
(NASA-CR-63623) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A flexible vacuum chamber, which permits increased test volume with increased pressure levels, has been designed to operate with cryowall removed, or with both cryowall and inner chamber wall removed. With both removed, the chamber is capable to pressures of about 2×10^{-8} torr, and test volume is 7 1/2 feet in diam and 12 ft long. With only the cryowall removed, the dimensions are about 6 1/2 ft by 8 1/2 ft, pressure is about 5×10^{-10} torr, and the inner chamber wall can dissipate a 10 kW heat load at temperatures below −300° F. When both walls remain, test volume is reduced to 5 1/2 ft by 7 ft, and pressure to about 5×10^{-11} torr. The cryowall can dissipate a 5 kW heat load at less than −300° F, a 2 kW at less than 20° K, or a 1.4 kW at liquid helium temperatures. Design details are given for the vacuum vessel, cryowall, inner chamber wall, pumping and bakeout systems, feed-throughs, and auxiliary features. The system is arranged so that it can be returned to atmospheric pressure with dry nitrogen gas. This dry nitrogen system is also used for pressure control. M.W.R.

N65-27401# Royal Aircraft Establishment, Farnborough (England).
DESCRIPTION OF PITCH-ROLL SUPPORT RIG INSTALLATION DESIGNED FOR STING MOUNTED MODELS IN THE R.A.E., 4 FT. × 3 FT LOW-TURBULENCE TUNNEL
D. J. Kettle London, Min. of Aviation, Jul. 1964 12 p ref
(RAE-TN-AERO-2977)

This note describes the main features of a pitch-roll support rig which has been installed in the 4' × 3' low-turbulence wind tunnel at the R.A.E., Farnborough. The rig is designed particularly for sting mounted models having internally

mounted strain gauge balances. A brief description of the currently installed automatic data readout system giving a punched card output, is given. The system produces also a typed record of the balance servo readings, so providing a running check on the results. Provision also has been made for conversion to punched paper tape output when this is required. Author

N65-27470 European Organization for Nuclear Research, Geneva (Switzerland).
A METHOD OF INCREASING THE SPACE-CHARGE LIMIT OF THE CERN PROTON SYNCHROTRON
Aimar Sorenssen 20 May 1965 14 p refs
(CERN-65-18)

To increase the power of a proton synchrotron, an instrumental method is proposed to counteract the space-charge forces in it. The distinctive feature of the method is that it avoids nonuniformity in Q-depression among the particles. A quadrupole lens, which is short compared with the length of a bunch, is given an excitation proportional to the instantaneous line-charge density inside the quadrupole. As a result of this, small and large synchrotron oscillations are treated differently. Two separate quadrupoles are necessary to take care of the space-charge forces in the vertical as well as the horizontal direction. Calculations of the necessary focusing powers of the lenses are given. Effective values of the excitation current are also computed. The difficult technical problem of making precise compensations of the space-charge force for all parts of each bunch is discussed. J.M.D.

N65-27659# Harvard Coll. Observatory, Cambridge, Mass.
SHOCK TUBE SPECTROSCOPY LABORATORY Annual Report
W. H. Parkinson and E. M. Reeves Feb. 1965 7 p refs
(Contract Nonr-1866(48))
(AD-612923)

Spectra of calcium, aluminum and iron were obtained in a temperature range 1500 to 2500 degrees over the wavelength region 2450 to 1650A from a carbon tube furnace. The results are compared to the results obtained from shock tubes. TAB

N65-27944*# National Aeronautics and Space Administration, Washington, D. C.
ELECTRICAL POWER MANAGEMENT STANDARD
15 Jun. 1965 36 p
(NASA-SP-6005; CMO-19-000-1) CFSTI: HC $2.00/MF $0.50
CSCL 05A

This document establishes a system for the management of electrical power source, load, and distribution properties during procurement and use of space vehicles or portions thereof. It is designed to permit the acquisition of systematized, verifiable, and controllable electrical power properties of vehicle systems and to facilitate rapid establishment and reporting of inputs for the source/load relationship. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-26844 Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
AN ABSTRACT OF CURRENT WORK IN TWO PHASE FLOW AT M.I.T.
P. Griffith, R. Haberstroh, and S. Rose *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 391 refs (See N65-26812 16-33) CFSTI: $5.50

An abstract discussing slug-annular regime boundary and flow properties of bubbly mixtures from current work in two-phase flow at M.I.T. is presented. In the slug-annular flow regime boundary study, an electrical conductivity probe is used to detect the existence of bridges of liquid across the center of the pipe. The presence of these bridges is taken to indicate slug flow. The dividing line between the bridges and no bridges condition is given by two equations. To study flow properties of bubbly mixtures, a direct measurement of wall friction, void, and momentum is made for a bubbly mixture. Results of this measurement are presented. N.E.A.

N65-26845 Dartmouth Coll., Hanover, N. H. Thayer School of Engineering.
TWO PHASE FLOW RESEARCH AT DARTMOUTH COLLEGE
G. B. Wallis *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 393–406 refs (See N65-26812 16-33) CFSTI: $5.50

Two-phase flow studies have been mostly concerned with the annular flow regime. Both the basic dynamics of this regime and the ways in which it can break down into other flow configurations have been investigated. Discussions are given on liquid film stability, upwards concurrent annular flow, and flow regime boundaries. N.E.A.

N65-26846 Argonne National Lab., Ill.
BUILDING 11: TWO PHASE FLOW PROGRAM
M. Petrick *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 407–439 (See N65-26812 16-33) CFSTI: $5.50

The Building 11 Two-Phase Flow Program is a cooperative research effort designed to promote and conduct basic research on two-phase flow problems. The projects that are currently under way are as follows: (1) a study of two-phase flow parameters during the complete vaporization of a fluid; (2) inception of hydrodynamic instability in a neutral instability loop; (3) power-to-void transfer functions; (4) study of the propagation of void waves in an air–water system by means of an electrical resistivity probe; (5) investigation of the instability in a loop near the thermodynamic critical point; (6) investigation of critical two-phase flow; and (7) the development of a fluoroscope for studying two-phase flow patterns in high pressure systems. Brief descriptions of these projects are given. N.E.A.

N65-26847 Allis-Chalmers Mfg. Co., Milwaukee, Wis.
PROGRESS IN VAPOR VOLUME FRACTION PROGRAM
K. F. Neusen *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 441–458 refs (See N65-26812 16-33) CFSTI: $5.50

Work currently being performed concerns the measurement of vapor volume fractions in a large unheated duct. A wide range of flow conditions with particular emphasis on low liquid velocities is being investigated. The schedule of flow conditions includes runs at zero net liquid flow. On the other end of the flow range, the investigation will include 20 fps liquid velocities. All the experiments are being conducted in a 2.9 inch pipe. Since vapor volume fraction is recognized as a fundamental parameter, a better understanding of its relationship to more easily measured parameters is necessary in advancing two-phase. The method of void fraction measurements is the gamma ray attenuation technique. A description of some of the results that have been obtained in the program is presented. It is concluded that with the work completed to date, the vapor volume fraction investigation has

produced some data with very interesting trends. As the experimenting proceeds to higher velocities and greater average voids, a more complete picture of void fraction in an unheated duct should be forthcoming. N.E.A.

N65-26848 General Electric Co., Schenectady, N. Y. Atomic Power Equipment Dept.
TWO-PHASE PRESSURE DROP
E. Janssen, J. A. Kervinen, and S. Levy *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 459–478 refs (See N65-26812 16-33) CFSTI: $5.50

Investigations of two-phase pressure drop was divided into three tasks. Task A was concerned with the adiabatic two-phase flow of high pressure steam–water mixtures past simplified contraction and expansion geometries. Task B was concerned with the same flow conditions in straight rectangular and circular channels, with particular emphasis on the high qualities. Task C was concerned with two-phase flow of high pressure steam-water in a straight channel with heat addition. The experimental work included measurements of two-phase pressure drop and steam void fraction, and taking of some high speed movie sequences. A description of some of the completed work is presented under voids, two-phase pressure loss, straight channels, and contraction and expansion. N.E.A.

N65-26849 Hanford Atomic Products Operation, Richland, Wash.
CRITICAL FLOW OF STEAM–WATER MIXTURES THROUGH SHORT PIPES
J. M. Batch *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 479–481 refs (See N65-26812 16-33) CFSTI: $5.50

The critical discharge of steam–water mixtures from a short piece of pipe was studied at upstream pressures approaching 2000 psia. When a two-phase mixture entered the test section, flow-choking conditions were observed to occur at the end of the test section, and data demonstrated correspondence with the predictions of the Fauske critical-flow theory. When compressed water entered the pipe and was required to flash to a steam–water mixture in the length of the pipe or in the conical approach section, the location of the primary choking was observed at the entrance of the pipe rather than at the exit where it is normally assumed to exist. For these cases, the flow rates were considerably greater than predicted by the Fauske theory based upon corresponding exit conditions. Typical results are shown for the data taken at stagnation enthalpies between 463 and 473 Btu/lb. During the existence of upstream choking, the pressure at the entrance of the pipe was observed to remain at the saturation value regardless of flow rate. It was found that this data could be correlated by an equation with maximum deviation of 10 percent. N.E.A.

N65-26850 Hanford Atomic Products Operation, Richland, Wash.
TWO-PHASE PRESSURE DROP IN PIPING COMPONENTS
J. M. Batch *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 483–487 (See N65-26812 16-33) CFSTI: $5.50

Pressure losses resulting from the flow of both liquid and steam–water mixtures were determined for horizontal 2-inch pipe and various piping components. The components included 90-degree bends of 2-inch, 3-inch, and 10-inch radius of curvature, a branch tree, and values of both gate and globe design. The study included expansions of 2- by 3-inch and 1-1/2- by 2-inch pipe; contractions of 3- by 2-inch, 2- by 1-1/2-inch and 2- by 1-inch pipe; and an orifice with an opening to pipe diameter ratio of 0.80. Data were obtained at mass velocities from 1 000 000 to 4 000 000 lb_m/hr-sq ft in the two-inch pipe and at steam qualities up to 24 percent by weight. Most of the data were obtained at 1200 psia while a selected number of experiments were performed at 800 psia and 600 psia. Two-phase to single-phase pressure-drop ratios for the straight pipe were correlated favorably by the Levy momentum exchange model. The ratios of the two-phase to single-phase pressure drop were different for the various bends; the maximum being for the 3-inch radius bend with ratios two and one-half times the straight ratios. Data showing the two-phase to single-phase pressure drop ratios for both expansions and contractions is presented. N.E.A.

N65-26853 Minnesota Univ., Minneapolis.
TWO-PHASE FLOW THROUGH APERTURES
H. S. Isbin *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 507–528 (See N65-26812 16-33) CFSTI: $5.50

Apertures are defined as any type of opening varying from sharp-edged orifices to tapered and contoured sections including short tubes. The study of two-phase, steam-water flows through apertures are aimed at acquiring a better understanding of the phenomena associated with loss-of-coolant accidents and the release rates of coolants from breaks in the reactor vessel and piping. Details of the flow in apertures are being investigated experimentally and are being coupled with analytical models to yield predictive methods. A sketch of the experimental equipment is given and a photograph of the assembly is presented. The results of all tests to date with saturated water in the tank indicate that no flashing occurs within the tank even though the accelerating flows lead to marked decreases in pressure in the neighborhood of the aperture. The flow of saturated water, from about 40 psig to 200 psig, through a variety of apertures is illustrated. N.E.A.

N65-26946# Maryland Univ., College Park. Dept. of Mechanical Engineering
AN EXPERIMENTAL STUDY OF THE EFFECTS OF BOUNDARY LAYER THICKNESS AND VELOCITY PROFILE ON THE PRESSURE DISTRIBUTIONS OF OBJECTS IMMERSED IN THE BOUNDARY LAYER
Clifford L. Sayre, Jr. Feb. 1965 40 p refs
(Contract Nonr-595(19))
(ME-595(19); AD-463575)

Pressure distributions were measured on six models in three different boundary layer conditions. Two hemispheres, two semicylinders, and two half bodies of revolution were used in the tests. The range of Reynolds numbers for the hemispheres and semicylinders was from 0.6×10^5 to 1.6×10^5 (based on diameter and free stream velocity). The boundary layer thicknesses ranged from about one-half to twice the characteristic model dimension. The effect of increasing boundary layer thickness (or momentum thickness) was a reduction in the positive and negative ordinates of the pressure distributions. The pressures on three-dimensional models were approximately the same at a given longitudinal station, although there may have been a small reduction in pressures close to the wall on which the object was mounted. No simple relationship could be found for relating the changes in pressure distribution to changes in velocity profile or boundary layer thickness, however a data correlation was obtained relating the minimum pressure coefficient for a particular boundary layer condition to the minimum pressure coefficient measured in a uniform flow. Author

N65-26951# Illinois Univ., Urbana.
TRANSIENT MEASUREMENTS BY VACUUM GAUGE SYSTEMS

S. L. Soo and A. B. Huang [1961] 39 p refs
(Contract AF 40(600)-909)
(AD-462036)

Response of a vacuum gauge in an envelope to the pressure of the environment was studied. Effects considered include adsorption and desorption from the surfaces and conductance of the conduit. Cases considered include step-wise change, linear time rate of change, and periodic variation of environment pressure. Results show that large time lag in the magnitude of pressure is expected in the envelope. It is also shown conclusively that a gauge in an envelope is not suitable for outer atmospheric study with a sounding rocket or an orbiting satellite. Response behavior of a nude gauge was studied. It is shown that a nude gauge should be used for such purposes. Author

N65-26973# Boeing Scientific Research Labs., Seattle, Wash.
AN EXPERIMENTAL INVESTIGATION OF MASS FLOW THROUGH SHORT CIRCULAR TUBES IN THE TRANSITION FLOW REGIME Flight Sciences Laboratory Report No. 95
A. K. Sreekanth Apr. 1965 74 p refs
(DI-82-0427)

The mass flow of nitrogen gas through short circular tubes was measured in the transition flow regime with the length-to-diameter ratios varied between 0.005 and 1 and with pressure ratios across the tubes varied between 1 and 20. The range of Knudsen numbers (ratio of upstream mean free path to the diameter of the tube) covered was between 0.1 to 1.7. Comparisons are made of the measurements with existing theories, and a semi-empirical equation is developed to correlate the measured data at all of the pressure ratios, Knudsen numbers, and length-to-diameter ratios covered in the present study. Author

N65-26997# Aeronautical Research Labs., Melbourne (Australia).
HOLE SIZE EFFECT ON MEASURED PRESSURE DISTRIBUTION ON A HEMISPHERE CYLINDER IN HYPERSONIC FLOW
M. J. Williams Apr. 1964 26 p refs
(ARL/A-227)

Pressure distributions on hemispherically-headed cylindrical bodies have been measured at M = 7.1 The effect of hole size on pressure readings has been studied over the region 30 to 60 degrees from the nose and an attempt made to correlate published data. The range of testing was at comparatively low Reynolds numbers but using published data it was estimated that any effect due to this parameter is less than 3% for a variation of Reynolds number of 100 times. After-body pressures agree well with other published data and theory, the effect of Reynolds number being again small. The circumferential variation of pressure at one station on the after-body for a small range of incidence angles has also been measured. Author

N65-27038# Gt. Brit. Ministry of Aviation, Mottingham.
THE LOSSES AT SUDDEN EXPANSION OF FLOW [OORASCHETE POTER' PRI VNEXAPNOM RASSHIRENII POTOKA]
A. E. Zariankin and L. V. Mikhnenkov May 1965 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), v. 3, 1964 p 50–57

The problem of the sudden change in cross section of a flow which occurs frequently in the investigation of losses in turbomachinery is presented. Suitable equations are derived for cases which differ in associated conditions and the numerical limits for a degree of widening are proposed. R.N.A.

N65-27224# Royal Aircraft Establishment, Farnborough (England).
ON SOME RECENT RESULTS IN THE FIELD OF BOUNDARY LAYER ASPIRATION FOR RETAINING LAMINAR FLOW AT HIGH REYNOLDS NUMBERS [UBER EINIGE NEUERE ERGEBNISSE AUF DEM GEBIET DER GRENZSCHICHTABSAUGUNG ZUR LAMINARERHALTUNG BEI HOHEN REYNOLDS-ZAHLEN]
W. Pfenninger Mar. 1965 43 p refs Transl. into ENGLISH of a lecture, 29 Aug. 1960
(RAE-LIB-TRANS-1100)

The present techniques for laminar boundary layer control are considered from both the wind tunnel and flight aspects. Various parameters are discussed, including the effects of the number of slits and their fineness, the stability criterion in the boundary layer, the influence of Mach No. and the problems of wing/body junctions. The practical application of the system is evaluated. Author

N65-27256# Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.
REPORTS OF THE INSTITUTE OF HIGH SPEED MECHANICS, VOLUME 16, 1964–1965
[1965] 252 p refs *Its* Sci. Rept. Ser. B

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N65-27257 Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.
CAVITATION TESTS ON HYDROFOILS DESIGNED FOR ACCELERATING FLOW CASCADE. REPORT 3: FIVE PROFILES GENERATED FROM PRESCRIBED PRESSURE CONFIGURATIONS OF TYPES 1 AND 3

F. Numachi *In its* Rept. of the Inst. of High Speed Mech. [1965] p 1–33 refs Presented at ASME Winter Ann. Meeting, Philadelphia, 17–22 Nov. 1963 Submitted for Publication (See N65-26256 16-12)
(Rept.-151)

It has been demonstrated that profiles can be found which manifest extremely favorable characteristics when used as blade elements of a given cascade formation. The method of developing such profile forms is to begin by prescribing a suitable configuration for the pressure distribution around the profile, and then to work out theoretically the profile outline that should create the predetermined pressure distribution. In pursuance of the studies described in Reports 1 [1] and 2 [2] of the present series, five profiles were selected for tests among a number of them newly developed from various pressure configurations, taking due account of the experience gained with the previous experiments. One of the profiles tested proved to yield performance superior to any tried so far. Author

N65-27258 Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.
A METHOD TO REMOVE THE WALL EFFECTS ON SUPERCAVITATING FLOW. REPORT 1: THEORY FOR CASE OF SLOTTED WALL TUNNEL
R. Oba *In its* Rept. of the Inst. of High Speed Mech. [1965] p 35–49 refs Presented at 40th Gen. Meeting of the Japan Soc. of Mech. Engr., 2 Apr. 1963 Submitted for Publication (See N65-27256 16-12)
(Rept.-152)

It is theoretically found that suction water of comparatively little quantity through the slots on the top and bottom tunnel-wall has a sufficient effect on eliminating the wall effects, even in a fairly narrow channel section of a width-chord-ratio $t \geq 3$. And the suction water volume is also determined. Author

N65-27261 Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.
THEORY OF SHEAR FLOW THROUGH A CASCADE
M. Honda *In its* Rept. of the Inst. of High Speed Mech. [1965] p 86–118 refs Presented at 38th Gen. Meeting of the Japan Soc. of Mech. Engr., 4 Apr. 1961 Submitted for Publication (See N65-27256 16-12)
(Rept.-155)

This paper considers an inviscid shear flow through a cascade of aerofoils spanning two parallel plane walls, on the assumptions of thin aerofoil theory. The spanwise distribution of lift coefficient on aerofoils in this type of flow, the flow features far downstream from the cascade, i.e. those in the Trefftz plane, and the induced drag due to the non-uniformity of the spanwise distribution of lift are studied theoretically, with some numerical examples. Author

N65-27263 Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.
EFFECT OF SURFACE ROUGHNESS ON CAVITATION PERFORMANCE OF HYDROFOILS, REPORT I
F. Numachi, R. Oba, and I. Chida *In its* Rept. of the Inst. of High Speed Mech. [1965] p 137–158 refs Presented at ASME Winter Ann. Meeting, New York, 29 Nov.–4 Dec. 1964 (See N65-27256 16-12)
(Rept.-157)

The effect of surface roughness on hydrofoil characteristics, particularly cavitation performance, was studied experimentally. It was intended to initiate the first of a series of studies to examine the effect on mechanical characteristics, particularly efficiency, of the surface finishing accuracy of blades in axial-flow turbines and pumps. Author

N65-27264 Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.
EFFECT OF CAVITATION ON THE RATE OF FLOW OF A VENTURI TUBE [EINFLUSS DER KAVITATION AUF DIE DURCHFLUSSZAHL DER VENTURIDUSE]
F. Numachi and R. Kobayashi *In its* Rept. of the Inst. of High Speed Mech. [1965] p 159–182 refs In GERMAN Presented at 40th Gen. Meeting of Japan Soc. of Mech. Engr., 2 Apr. 1963 Submitted for Publication (See N65-27256 16-12)
(Rept.-158)

The setting and forming of cavitations in various kinds of standardized Venturi Tubes through which water was flowing, were investigated photographically. Their influence on the pressure indication and the rate of flow was determined. It showed that the rate of flow of standardized Venturi Tubes, even if cavitations occur, stays within standardized limits of tolerance, providing the number of cavitations does not fall below a certain limit. Author

N65-27265 Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.
THEORY ON BLADES OF DIAGONAL FLOW PUMPS AND WATER-TURBINES, REPORT 1
H. Murai *In its* Rept. of the Inst. of High Speed Mech. [1965] p 183–208 refs Presented at 34th and 35th Gen. Meetings of Japan Soc. of Mech. Engr., 2 Apr. 1957 and 2 Apr. 1958 (See N65-27256 16-12)
(Rept.-159)

A method is to be shown for the analytical calculation of the flow passing through the impellers or guide vanes with casings (or shrouds) and bosses, which are more or less of conical shape as in ordinary cases. Not only the flow passing through the blades but also the relationship between the shape and number of blades, circulation distribution and also the shape of casing and boss can be made clear analytically based on the theory in this report. Author

N65-27266 Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.
THEORY ON BLADES OF DIAGONAL FLOW PUMPS AND WATER-TURBINES, REPORT 2 (APPROXIMATE SOLUTION BY NUMERICAL TABLES)
H. Murai *In its* Rept. of the Inst. of High Speed Mech. [1965] p 209–231 refs Presented at 38th Gen. Meeting of Japan Soc. of Mech. Engr., 5 Apr. 1961 (See N65-27256 16-12)
(Rept.-160)

A simple method was devised for calculating the flow through blades of runners of diagonal flow machines by the use of numerical tables of induced velocities, which are represented in the generalized forms including three parameters independent on profile forms of blades and others. Author

N65-27280# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Freiburg (West Germany). Institut für Angewandte Mathematik und Mechanik.
STANDING WAVES IN FREE CONVECTION FLOW BETWEEN VERTICAL WALLS OF DIFFERENT TEMPERATURE [UBER STEHENDE WELLEN IN EINGER KONVEKTIONSSTROMUNG ZWISCHEN VERTIKALEN WANDEN VERSCHIEDENER TEMPERATUR]
H. Kappus and A. Lehmann Mar. 1965 28 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-15; DVL-414) Available from Zentralstelle fuer Luftfahrtdokumentation und Inform. (ZLDI), Munich: 7.10 DM

Standing waves of small amplitude in free convection flow of a viscous incompressible medium between vertical

walls of different temperature are considered. The perturbation equations together with the appropriate boundary conditions constitute an ordinary eigenvalue problem of 12th order. A computer solution is obtained using an orthogonal expansion technique (Galerkin's method). The Grashof number as function of the wave number for the marginal state (neutral curve) and the values of some eigenfunctions are given. Author

N65-27299*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PREDICTION OF PROPELLANT TANK PRESSURIZATION REQUIREMENTS BY DIMENSIONAL ANALYSIS
J. F. Thompson and M. E. Nein 16 Mar. 1965 26 p refs
(NASA-TM-X-53218) CFSTI: HC $2.00/MF $0.50 CSCL 21H

Pressurant gas requirements for launch and space vehicles may be predicted by analytical models of the pressurization process. However, preliminary design studies require a fast and reasonably accurate method of predicting without resorting to computer programs. Therefore, dimensional analysis of a large number of pressurization tests and computer runs was applied to develop an equation that predicts pressurant requirements for cylindrical and spheroidal propellant tanks with an accuracy of ±10 per cent. Author

N65-27522# California Inst. of Tech., Pasadena. Hydrodynamics Lab.
A CLASS OF MULTIPLE INTEGRALS OF THE STATIONARY PHASE TYPE OCCURRING IN THE THEORY OF WATER WAVES
D. K. Ai Mar. 1965 30 p refs
(Contract Nonr-220(41))
(E-111.4; AD-613973)

A class of integrals which often occur in water wave problems are treated in this report. It is shown that these integrals are closely related to exponential integrals of complex arguments. A subroutine written in Fortran IV language is also given to serve as an example for numerical calculation. Author

N65-27543# General Telephone and Electronics Labs., Inc. Bayside, N. Y.
STUDY OF ABSORPTION OF GASES ON SOLIDS IN THE HIGH VACUUM RANGE Final Report, 1 Jan. 1962–31 Dec. 1964
C. M. Bliven and J. V. Florio 28 Feb. 1965 56 p refs
(Contract AF 19(628)-331)
(TR-65-255.9; AFCRL-65-137; AD-615040)

Investigation of the interaction of nitrogen with a hot tungsten filament showed that a chemical pumping effect occurs and that the magnitude of this effect varied with temperature. The sticking probability of nitrogen on tungsten, measured as a function of surface coverage, was calculated to be a maximum of 0.24 at a surface coverage of 7×10^{13} molecules/cm^2. In studies of the adsorption of oxygen on molybdenum and tungsten, the sticking probability and molybdenum work function changes were calculated as a function of oxygen surface coverage, neglecting the carbon monoxide background caused by chemical reactions between the oxygen and carbon impurities in the tube parts. For the adsorption of carbon monoxide on molybdenum, the calculated value of initial sticking probability (0.05) and total number of adsorbed molecules (2×10^{13} molecules/cm^2) are considerably smaller than expected, probably due to reversible sorption processes. The work function changes resulting from the adsorption of carbon monoxide on polycrystalline tungsten were in good agreement with results reported for single crystal tungsten. Author

N65-27547# Clemson Coll., S. C. Coll. of Engineering.
SPLITTER EFFECT IN CONICAL DIFFUSERS. PART 1: EXPERIMENTAL PHASE INCOMPRESSIBLE FLOW
Tah-teh Yang Mar. 1965 51 p refs *Its* Bull. 103
(Contract DA-31-124-ARO(D)-148)
(AROD-4390-1; AD-615573)

The effects of a ring-airfoil used as a splitter in a conical diffuser have been critically examined. The influence of a ring-airfoil on (a) turbulence intensity and boundary layer profile at the diffuser inlet, (b) velocity distributions across the diffuser at stations along the main flow direction, (c) the growth of boundary layer and the velocity gradient at the diffuser wall and (d) the pressure field inside the diffuser, are presented and discussed. The conclusions of this investigation are: (1) The diffuser performance improvement was attributed to the induced velocity around the airfoil, which modified the pressure field inside the diffuser. (2) The diffuser inlet velocity profile and turbulence intensity were very secondary effects. The experimental results were summarized in a partial performance map, which can be used as a designer's guide. The map shows that diffuser pressure recovery efficiency can be increased from 55% to 72%, and improvement of 31% by placing a thin, ring-airfoil in the diffuser as a splitter. Author

N65-27556# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IMPINGEMENT OF AN ANNULAR JET ON A SCREEN
V. I. Khanzhonkov 9 Apr. 1965 31 p Transl. into ENGLISH from Tsentr. Aero-Gidrodinamicheskiy Inst., Prom. Aerodynamika (USSR), no. 23, 1962 p 174–199
(FTD-TT-64-513/1+2; AD-614760)

An attempt is made to clear up by the experimental method the aerodynamic characteristics of annular nozzles and to investigate the flow of an annular jet impinging on a flat screen. This is done by determining the pressure, both along the bottom of the annular nozzle and over the screen on which the annular jet impinges. The experimental setup and the method of processing the results of the tests are described.
N.E.A.

N65-27562# Curtiss-Wright Corp., Wood-Ridge, N. J. Wright Aeronautical Div.
A CONTINUATION OF THE BASIC STUDY OF SLENDER CHANNEL ELECTROGASDYNAMICS
Bernard Kahn Wright-Patterson AFB, Ohio, ARL, Jan. 1965 94 p refs
(Contract AF 33(657)-10892)
(ARL-65-4; AD-614907)

These studies involve a detailed experimental and analytical program investigating the phenomenon of generating electric power by causing a supply of unipolar ions to be forced to flow against an opposing induced electric field in an energy conversion channel. In this phase of the program, charged colloid particles are produced by induced condensation in a flow nozzle and an increase in output current is observed. A corona discharge is used as a means of neutralizing the charged particles. By adjusting the ionizer needle position, all the current can be transported downstream to the collector in a supersonic flow. Also, the phenomenon of EGD power generation is observed to continue after the ionizer power input is removed. The performance of EGD generators is analyzed and the results show that the ratio of optimum length to diameter is a function of the ratio of friction forces to body forces. An analysis is prepared on the mobility of aerosol particles. Optical methods to determine particle size and number density in a steady flow are presented. Author

N65-27564# ARO, Inc., Arnold Air Force Station, Tenn.
THE NONEQUILIBRIUM EXPANSION OF A DIATOMIC GAS THROUGH A CONVERGENT-DIVERGENT NOZZLE, SEPTEMBER 1963–JANUARY 1965
Max Kinslow and J. T. Miller Arnold Eng. Develop. Center, Jun. 1965 24 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-103; AD-464533)

This report is addressed to the problem of predicting the flow properties of a high temperature gas expanding through a hypersonic nozzle. The basic equations for the conservation of mass, momentum, and energy are applied to the one-dimensional flow of an inviscid, adiabatic gas with finite vibrational relaxation and dissociation recombination rates. These equations are integrated exactly, where possible, to give an integral equation containing only temperature and the parameters of the lagging processes, vibrational energy, and mass fraction of atoms. Together with the rate equations, which are integrated, these equations are solved by an iteration technique on a digital computer for the flow through a hypersonic nozzle starting from an initial condition. A condition is also found which must be satisfied at a critical point near the minimum area of the nozzle. This critical point then serves as a starting point in the nozzle from which conditions both upstream and downstream can be determined. These basic methods are applied to calculate the flow properties along the nozzle of an arc-heated, low-density, hypersonic wind tunnel operated with nitrogen gas. The calculations are in substantial agreement with measurements. Author

N65-27568# Aeronautical Research Council (Gt. Brit.)
MACH NUMBER DISTRIBUTIONS ALONG THE SLOTTED WALLS OF THE N.P.L. 20 IN. × 8 IN. HIGH-SPEED WIND TUNNEL
H. H. Pearcey and J. D. Regan London, HMSO, Jul. 1958 23 p refs Supersedes ARC-20287
(ARC-CP-784; ARC-20287) HMSO: 4s 6d

A brief description is given of a new working section fitted to the N.P.L. 20 in. × 8 in. high-speed wind tunnel to incorporate slotted walls. Mach number distributions along these walls are given to show the improvement effected by placing perforated screens in the plenum chambers, and the influence of the model on the measurement of tunnel speed. Author

N65-27597# Michigan Univ., Ann Arbor.
INITIAL STUDIES OF CONDENSING METAL VAPORS CARRIED BY EXPANDING INERT GASES
Kenneth R. Sivier, Pai-Lien Lu, Donald D. Mc Bride, and Erol Oktay Wright-Patterson AFB, Ohio, ARL, Mar. 1965 142 p refs
(Contract AF 33(657)-8867)
(ARL-65-59; AD-615559)

A report is presented on the progress of an experimental investigation of the condensation of metal vapors carried by an expanding inert gas initially at high pressure. This investigation has emphasized some initial experiments in The University of Michigan's Hotshot Wind Tunnel and a study of instrumentation techniques. Three zinc-in-helium tests in the Hotshot tunnel have indicated that the metallic condensate occurs in the form of very small particles; most particles were found to have diameters of from 0.01 to 0.1 microns. These particles were collected on impact probes from the hypersonic nozzle flow and analysed by electronmicroscopy. A spectrographic analysis of the particle samples showed that roughly one percent by mass of contaminants (principally copper, iron, and silicon) were added to the zinc in the hotshot arc chamber. In addition to direct particle sampling, the techniques of light scattering and photomicrography (direct photography of the condensed particles) have been investigated. The study of light scattering has progressed to a bench set-up for evaluation and calibration of a system that measures light attenuation by the scattering medium. Although indicating the possibility of the photography of one micron diameter particles traveling at high speed, the study of the photomicrography techniques has been discontinued in view of the very small particle sizes indicated by the direct samples from the zinc-in-helium tests. Author

N65-27633# Royal Aircraft Establishment, Farnborough (England).
APPROXIMATE CALCULATION OF THE TURBULENT BOUNDARY LAYER IN TWO-DIMENSIONAL INCOMPRESSIBLE FLOW
E. C. Maskell London, Min. of Supply, Nov. 1951 62 p refs
(RAE-AERO-2443)

An approximate method is constructed for calculating the development of the turbulent boundary layer, given the velocity distribution outside the layer. The characteristics which may be determined are those of greatest practical interest: namely, the momentum thickness, θ, the profile parameter, H, the skin-friction coefficient, c_f, and the separation point. By making use of an empirical approximation, the momentum equation is directly integrated to determine θ. This greatly reduces the computation compared with previous methods. The profile parameter is determined from an empirical differential equation similar in form to the von Doenhoff-Tetervin and Garner equations, but more generally valid. The Ludwieg-Tillmann formula is used to calculate the skin-friction and, by extrapolation, to determine the separation point. A tentative procedure is proposed for predicting the initial value, H_1, of the profile param-

N65-27740# California Inst. of Tech., Pasadena. Hydrodynamics Lab.
THE WALL EFFECT IN CAVITY FLOW
Daniel K. Ai and Z. L. Harrison Apr. 1965 29 p refs
(Contract Nonr-220(41))
(Rept.-111-3; AD-463879)

A non-linear theory for the calculation of the flow field of an oblique flat plate under blockage condition is given using the techniques of integral equations. Numerical results are obtained with the aid of a high speed digital computer for the plate situated mid-channel at values of the angle of attack from 5° to 90° and the channel width-chord ratio from 3 to 20. Also obtained are results for the plate situated at two different off-center positions for a channel width-chord ratio 5 and angles of attack less than 30° Author

N65-27747# Toronto Univ. (Ontario). Inst. for Aerospace Studies
THE COANDA EFFECT AT DEFLECTION SURFACES WIDELY SEPARATED FROM THE JET NOZZLE
S. D. Benner Apr. 1965 83 p refs
(Contract DA-44-177-AMC-11(T))
(UTIAS-TN-78; AD-610525)

This experimental investigation of the deflection of two-dimensional jet sheets by means of the Coanda Effect by surfaces widely separated from the nozzle in both the horizontal and the vertical direction has again shown that the Coanda Effect is not limited to attached deflection surfaces or to inclined single or multiple flat-plate surfaces. The horizontally ejected subsonic and over-chocked jet sheets successfully bridged horizontal and vertical gaps of 32 and 10 times the nominal jet sheet thickness (t = 1/16-inch) respectively; for t = 1/4-inch, the corresponding ratios were eight and two. The vertical gap was increased until the flow detached from the deflection surface. Vertical and horizontal forces acting on three different deflection surfaces, formed by a combination of an initial flat plate (1/4-inch

thick) followed by a quadrant of a circular cylinder of 2-, 3-, and 4-inch radius, were measured with a strain gauge balance. The configurations were tested at nominal pressure ratios of 1.1, 1.2, 1.7, and 2.2, and the surface pressures were recorded. Author

N65-27755# Northrop Corp., Hawthorne, Calif. Norair Div.
NUMERICAL METHODS AND FORTRAN PROGRAM FOR FLOW FIELD CALCULATIONS IN SUPERSONIC CASCADES
J. Der, Jr. and B. N. Mullings Wright-Patterson AFB, Ohio, ARL, Oct. 1964 230 p refs
(Contract AF 33(657)-8851)
(ARL-64-146; AD-609013)

The results presented in this report are a continuation of the work reported earlier in ARL 63-117. This report describes methods and an IBM FORTRAN II program for the calculation of internal viscous and inviscid flow fields within the channels of a supersonic cascade. Methods included are: (1) a second order Belotserkovskii procedure for calculating the flow field around the forward part of blunt blades, (2) a general method of characteristics procedure for calculating supersonic flow fields, (3) automatic procedures for calculating interactions of shocks of the same and opposite families, shock interactions with a wall and with a vortex sheet or slip-stream, envelope shock formation, and (4) a finite-difference procedure for calculating the laminar boundary layer, which includes a method of suction calculation for maintaining a non-separated boundary layer under an adverse pressure gradient. Computed results are presented for three sharp leading edge channel configurations at $M_\infty = 4.0$. These results show that a convergent–divergent passage is desirable when turning a supersonic stream. Computed results are also shown for a rotationally symmetric $M_\infty = 4$ inlet by the same basic technique. The complete FORTRAN listing of the program and a summary of the equations are included as Appendices. Author

N65-27759# Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
MEASUREMENTS OF THE UNSTEADY FORCE ON CAVITATING HYDROFOILS IN A FREE JET
C. S. Song Jun. 1964 58 p refs Its Series B, Technical Paper No. 49 Jun. 1964 58 p refs *Its* Tech. Paper No. 49, Ser. B
(Contract Nonr-710(24))
(AD-610385)

Experimental data concerning force and other related quantities associated with unsteady supercavitating flow about bodies tested in a freejet water tunnel are reported herein. Three types of unsteady flows were studied—those due to pitching oscillation, sudden ventilation, and sudden angle of attack change. All test bodies were of such geometrical configuration that separation could occur only at two or three fixed points. An attempt was also made to measure the response of the flow to a sudden angle of attack change. It was concluded that, due to the oscillatory nature of the cavity, a faster angle of attack change than was attained in the experiment is needed to obtain a useful unit function response curve. Author

N65-27763# Virginia Univ., Charlottesville.
PROJECT SQUID Semiannual Progress Report, 1 Oct. 1964–31 Mar. 1965
G. Rudinger et al 1 Apr. 1965 66 p refs
(Contract Nonr-3623(00))
(AD-464697)

Reports of progress during the past 6 months on 13 research programs comprising Project SQUID are presented. The research programs fall into the areas of Fluid Mechanics, Transport and Transfer Processes, Chemical Kinetics, and Combustion Phenomena. Project SQUID is a cooperative program of basic research relating to Jet Propulsion, administered by the University of Virginia and sponsored by the Office of Naval Research. Author

N65-27765# Aberdeen Proving Ground, Md. Exterior Ballistics Lab.
ASYMPTOTIC SOLUTIONS FOR THE EXPANSION OF GAS INTO VACUUM
Erich H. Wedemeyer Apr. 1965 23 p refs
(BRL-R-1278; AD-465240)

When a spherical or cylindrical gas cloud expands into vacuum, the resultant flow becomes asymptotically self-similar and independent of the original cloud diameter. An analytic solution for the asymptotic density profiles, given by Mirels and Mullen is re-examined and a new solution proposed, which gives better agreement with numerical computations. Some applications of the asymptotic solutions are discussed. Author

N65-27766# David Taylor Model Basin, Washington, D. C. Hydromechanics Lab.
SURVEY OF STEADY LIFT AND MOMENT ON TWO-DIMENSIONAL FLAT-PLATE HYDROFOILS BENEATH A FREE SURFACE AT VARIOUS CAVITATION NUMBERS
John H. Pattison Mar. 1965 30 p refs
(DTMB-1776; AD-465585)

This report reviews and summarizes previous theoretical and experimental work done to predict the steady lift force and moment on two-dimensional flat-plate hydrofoils. The analyses are different for different flow conditions based on cavitation and depth of submergence. The results are discussed according to three cavitation conditions: fully wetted flow, partially cavitated flow, and fully cavitated flow; and according to three depth Froude number conditions: $0 \leq F_h < 0.3$ (large depth or low speed), $0.3 < F_h < 2$ (critical depth and speed), and $2 < F_h \leq \infty$ (small depth or high speed). Author

N65-27811*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOME VISUAL OBSERVATIONS OF CAVITATION IN ROTATING MACHINERY
Richard F. Soltis Washington, NASA, Jul. 1965 19 p refs
(NASA-TN-D-2681) CFSTI: HC $1.00/MF $0.50 CSCL 20D

Visual studies of cavitation within a rotating blade row have contributed significantly toward an improved understanding of flow patterns and cavity formations. This report documents and discusses some of the forms of cavitation both steady and unsteady, that have been observed in several pump rotors operated in water at room temperatures. The behavior of these different forms of cavitation with varying operating conditions is noted, and a correlation is made between visual observations and measured performance. Author

N65-27823*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LIQUID CAVITATION STUDIES IN CIRCULAR PIPE BENDS
R. E. Stonemetz 14 Jun. 1965 26 p refs
(NASA-TM-X-53278) CFSTI: HC $2.00/MF $0.50 CSCL 20D

Incipient cavitation indices were determined for various circular pipe bends using water as the working fluid. For all configurations investigated, the cavitation index decreased with increasing Reynolds Number and ratio of the fluid vapor pressure to the upstream dynamic pressure. The critical cavitation index was greater for smaller ratios of bend radii to pipe diameter; the angle of the bend had little effect. An empirical relationship was derived for the determination of the critical cavitation index. This relationship takes into account the effects of bend radius and pipe diameter. Author

N65-27868# Heliodyne Corp., Los Angeles, Calif.
STABILITY OF DUST LADEN AXISYMMETRIC LAMINAR WAKES
Ali Hasan Nayfeh Feb. 1965 52 p refs
(Contract DA-04-495-AMC-458(Z); ARPA Order 360; Proj. Defender)
(RR-9; AD-461488)

The stability of dust laden axisymmetric laminar wakes is investigated and a single equation for the amplitude of the pressure disturbance is derived. The stability problem is reduced to solving a complicated eigenvalue problem. The solution is sought by perturbing the dust-free problem for small mass fraction of dust to gas. As in the two-dimensional case, the problem is of the singular perturbation type due to a nonuniformity of the straightforward perturbation expansion far away from the wake axis. As in the two-dimensional case, the results show that the effect of the dust can be stabilizing as well as destabilizing, depending on the size of the dust particles and their distribution. The magnitude of the amplification or damping factor depends on the wave velocity, velocity defect, and temperature excess at the wake axis. Author

N65-27968# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
A CONICAL THIN-SHOCK-LAYER THEORY UNIFORMLY VALID IN THE ENTROPY LAYER
Robert E. Melnik Wright-Patterson AFB, Ohio, Flight Dyn. Lab., Jan. 1965 230 p refs Prepared jointly with Aeron. Res. Associates of Princeton, Inc.
(Contract AF 33(657)-7313)
(FDL-TDR-64-82; AD-614444)

The thin-shock-layer theory of hypersonic flow over general conical surfaces is discussed, and a two layer solution and the associated composite expansion that is uniformly valid in the entropy layer is derived. Formulas for the first two terms of the various expansions are given in terms of a number of quadratures. The general character of the entropy layer corrections was evaluated for the first order terms of the expansions for the case of hypersonic flow over a slightly yawed circular cone and in the case of flow in the vicinity of a conical symmetry plane. The first order uniformly valid solution for the conical symmetry plane has a particularly simple form that clearly illustrates the analytic character of the solution. Plots of the stream function distribution near the symmetry plane clearly show a distinctive boundary layer behavior near the cone surface. The pertinence of these results to the study of the behavior of conical flows in the vicinity of nodal points is discussed. Further, the generalization of the theory to pointed surfaces is included. E.E.B.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-26806# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS FROM GEOLOGIYA I GEOFIZIKA (GEOLOGY AND GEOPHYSICS), NO. 1, JANUARY 1965
18 Jun. 1965 86 p refs Transl. into ENGLISH from Geol. i Geofiz., Akad Nauk SSSR, Sibirsk, Otd. (Novosibirsk), no. 1, Jan. 1965 p 11-20, 62-91, 151-159, 173-179
(JPRS-30679; TT-65-31291) CFSTI: $3.00

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1. ON THE PROBLEM OF THE PHYSICAL STATE OF ABYSSAL MATTER IN THE EARTH'S CRUST AND IN THE UPPER MANTLE IN THE KURILE ZONE OF THE PACIFIC BELT M. Kh. Livshits p 1-15 refs (See N65-26807 16-13)

2. STRUCTURE OF THE EARTH'S CRUST IN THE SOUTHERN PART OF THE WEST SIBERIAN LOWLAND S. V. Krylov, V. S. Surkov, and E. R. Mishen'kina p 16-31 refs (See N65-26808 16-13)

3. PROBABILITY OF FALSE EVENTS ON SEISMIC RECORDS S. V. Gol'din p 32-59 refs (See N65-26809 16-13)

4. TRAVEL-TIME CURVES OF SEISMIC WAVES AND THE THICKNESS OF THE EARTH'S CRUST IN THE ALTAY-SAYANSK FOLDED REGION FROM DATA OBTAINED BY RECORDING INDUSTRIAL EXPLOSIONS AND LOCAL EARTHQUAKES N. D. Zhalkovskiy, G. M. Tsibul'chik, and I. D. Tsibul'chik p 60-70 refs (See N65-26810 16-13)

5. A METHOD OF AUTOMATIC INTERPRETATION OF COMPLEX MAGNETIC ANOMALIES G. F. Kuznetsov p 71-83 refs (See N65-26811 16-13)

N65-26807 Joint Publications Research Service, Washington, D. C.
ON THE PROBLEM OF THE PHYSICAL STATE OF ABYSSAL MATTER IN THE EARTH'S CRUST AND IN THE UPPER MANTLE IN THE KURILE ZONE OF THE PACIFIC BELT
M. Kh. Livshits *In its* Transl. from Geol. i Geofiz. 18 Jun. 1965 p 1-15 refs (See N65-26806 16-13) CFSTI: $3.00

On the basis of a joint analysis of data from deep seismic sounding, gravimetry, magnetometry and seismology, it has been established that the matter of the upper mantle is nonhomogenous, expressed in a lesser density in the zone of the Kurile uplifts and a greater density in the zone of the Kurile-Kamchatkan downwarp. There was found to be a sharp difference in the deep structure of the northern Kurile and southern Kurile structural-tectonic zones and it is postulated that there is a profound difference in the geological history of these zones, combined in the recent epoch into the geomorphological and tectonic complex of the Kurile-Kamchatkan island arc. N.E.A.

N65-26808 Joint Publications Research Service, Washington, D. C.
STRUCTURE OF THE EARTH'S CRUST IN THE SOUTHERN PART OF THE WEST SIBERIAN LOWLAND
S. V. Krylov, V. S. Surkov, and E. R. Mishen'kina *In its* Transl. from Geol. i Geofiz. 18 Jun. 1965 p 16-31 refs (See N65-26806 16-13) CFSTI: $3.00

The deep structure of the earth's crust in the southern part of the West Siberian Lowland is discussed. As a result of the reinterpretation of data from deep seismic sounding, a cross section of the earth's crust along a 300 km profile in the West Siberian Lowland is constructed. On the basis of a joint study of geological and geophysical data there is a discussion of the problem of the nature of the deep discontinuities in the earth's crust and the relationship between gravity anomalies, and characteristics of the genesis and development of buried geological structure of this region. N.E.A.

N65-26809 Joint Publications Research Service, Washington, D. C.
PROBABILITY OF FALSE EVENTS ON SEISMIC RECORDS
S. V. Gol'din *In its* Transl. from Geol. i Geofiz. 18 Jun. 1965 p 32-59 refs (See N65-26806 16-13) CFSTI: $3.00

The probability of erroneous detection of a wave and the probability of missing a wave for the amplitude criterion of detection of seismic waves used in the visual correlation of seismogram and composite seismic records are discussed. The

problem of the selection of the optimal parameters of the criterion is also discussed. The influence of interference systems is evaluated. N.E.A.

N65-26810 Joint Publications Research Service, Washington, D. C.
TRAVEL-TIME CURVES OF SEISMIC WAVES AND THE THICKNESS OF THE EARTH'S CRUST IN THE ALTAY-SAYANSK FOLDED REGION FROM DATA OBTAINED BY RECORDING INDUSTRIAL EXPLOSIONS AND LOCAL EARTHQUAKES
N. D. Zhalkovskiy, G. M. Tsibul'chik, and I. D. Tsibul'chik *In its* Transl. from Geol. i Geofiz. 18 Jun. 1965 p 60–70 refs (See N65-26806 16-13) CFSTI: $3.00

For determination of the travel-time curves of longitudinal seismic waves in the Altaya-Sayanskaya region, more than 500 records of industrial explosions with epicentral distances ranging from eight to 470 km were analyzed. A comparison is made of the travel-time curve data and results obtained from local earthquakes. A discussion is presented on the characteristics of the travel-time curve patterns and related information concerning the thickness of the earth crust. N.E.A.

N65-26811 Joint Publications Research Service, Washington, D. C.
A METHOD OF AUTOMATIC INTERPRETATION OF COMPLEX MAGNETIC ANOMALIES
G. F. Kuznetsov *In its* Transl. from Geol. i Geofiz. 18 Jun. 1965 p 71–83 refs (See N65-26806 16-13) CFSTI: $3.00

On the basis of the principle of additiveness of magnetic fields and the concept of excessive magnetic mass in magnetic exploration, a method is proposed for the interpretation of magnetic anomalies in fields of any complexity. The basic principles of this method and the ways it can be used with an electronic computer is given. Concepts to facilitate description of the method and its algorithm are introduced. By using these concepts and assumptions it was possible to prepare a completely clear algorithm and program for carrying out the entire process of splitting a complex magnetic anomaly into elementary anomalies by using an electronic computer. Some specific characteristics of the problems arising when this method is used with an electronic computer and problems involved in using the algorithm are discussed. N.E.A.

N65-26968# Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography.
A STUDY OF THE INFORMATION CONTENT OF UMKEHR OBSERVATIONS Technical Report No. 2
Carlton L. Mateer (Ph.D. Thesis) Apr. 1964 215 p refs
(Grant NSF-G-19131)
(Rept.-04682-2-T)

A study is presented to determine the amount of vertical ozone distribution information contained in Umkehr observations with reference to the predictability of the so-called secondary ozone maximum in the lower stratosphere. The observations were examined to determine how many linearly independent pieces of information could be derived from an Umkehr curve. Empirical orthogonal functions were used, and the characteristic patterns of the Umkehr curve and their relative importance were determined. The linearized evaluation method of Deutsch was examined by eigenvalue analysis to determine the number of information pieces that could be determined. Both methods concluded that there were four pieces of information about the vertical ozone distribution to be determined. Conclusions were that there is no way of determining the existence of a distinct secondary maximum in the lower stratosphere from Umkehr observations, and that the vertical ozone distributions are to be compared with each other only when determined by the same objective technique. R.N.A.

N65-27016# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
GEOPHYSICAL SEISMIC EVALUATION STUDY AT HANFORD
R. E. Brown and J. R. Raymond Dec. 1964 42 p refs
(Contract AT(45-1)-1830)
(BNWL-47) CFSTI: $3.00

A geophysical research program was conducted at Hanford to: (1) determine the precision, detail, and kinds of data that can be obtained with seismic field techniques and data processing methods; (2) trace significant strata laterally from a well or between two existing wells to help confirm or refute recently developed well data correlations or concepts; and (3) determine the general applicability, cost, speed or seismic methods for possible production surveys at Hanford or other sites. Seven geological features were chosen for seismic detection and delineation. These seven features were divisible into two main groups: features that require penetration to the basalt surface and below the basalt surface. An evaluation and interpretation of results of the study is presented. It is concluded that the seismic evaluation study was successful in accomplishment of its aims. N.E.A.

N65-27034# Joint Publications Research Service, Washington, D. C.
SOME PECULIARITIES OF THE ENERGY SPECTRUM OF OCEANIC TURBULENCE
R. V. Ozmidov 29 Jun. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Mat., Fiz. (Moscow), v. 161, no. 4, 1965 p 828–831
(JPRS-30852; TT-65-31373) CFSTI: $1.00

Computations of the energy density distribution of large eddies in the ocean were made from available data on current velocities. It is shown that the distribution function follows the 5/3 power law satisfactorily. Also, it is shown that the period of the predominant variations was close to the period of tidal currents. A scheme of energy distribution for movements of ocean waters of different magnitudes is used to show the zones in which the energy distribution follows the 5/3 power law and the deviations from this law. E.E.B.

N65-27042# Kiruna Geophysical Observatory (Sweden).
KIRUNA GEOPHYSICAL DATA, JULY–SEPTEMBER 1964 Data Summary 64/3
W. Riedler, ed. [1964] 53 p

A collection of current geophysical data related to polar upper atmospheric conditions recorded in Sweden is presented. Data on geomagnetic K-indices, ionospheric absorption, VLF radio wave propagation, satellite recordings, visible auroral index, earth current amplitude, and magnetic pulsations are tabulated. Also included are diagrams on the mean and day to day variation of cosmic noise absorption, oblique VHF auroral echo occurence, and 16 kcs reception from Rugby, England. R.N.A.

N65-27043# Kiruna Geophysical Observatory (Sweden).
KIRUNA GEOPHYSICAL DATA, DATA SUMMARY 64/4, OCTOBER–DECEMBER 1964
W. Reidler, ed. [1964] 51 p

Geomagnetic K-indices, ionospheric absorption, oblique VHF auroral reflections, VLF radio wave propagation, visible auroral index, micropulsations, and earth currents data are presented for October to December 1964. E.E.B.

N65-27053*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TIROS VII RADIATION DATA CATALOGUE AND USERS' MANUAL, VOLUME 1, 19 JUNE–30 SEPTEMBER 1963

30 Sep. 1964 260 p refs

(NASA-TM-X-56580) CFSTI: HC $6.00/MF $1.50 CSCL 04A

General discussions about the nature of the experiment and the processing of data relating to TIROS VII are included. Among the subjects covered in detail are the medium resolution radiometer; calibration; radiation data processing, coverage, and documentation; and pre- and post-launch performance of the radiation experiment. It is concluded that the major limitation of the medium resolution radiometer experiment is the uncertainty of the absolute values of the measurements, which results from both the radiometer response degradation, and electronic degradation. Corrections are included, but they are based on estimates and may still contain appreciable uncertainties. Reduced radiation data for each orbit are documented in two appendixes. The *Index of Final Meteorological Radiation Tapes* is in tabular form, and the *Subpoint Track Summary of Available Radiation Data* is diagrammatic. M.W.R.

N65-27075# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

INTERNAL FRICTION OF H_2O, D_2O AND NATURAL GLACIER ICE

Daisuke Kuroiwa Jan. 1965 51 p refs

(CRREL-RR-131; AD-615732)

The three parts of this report are entitled (1) internal friction of pure H_2O, D_2O and doped ice crystals, (2) internal friction at crystal boundaries, and (3) the internal friction of natural glacier ice. Part 1 uses the flexural vibration method and expresses internal friction as a logarithmic decrement of free oscillation. Equations are given for the logarithmic decrement, internal friction, and the resonant frequency of a rectangular bar. In Part 2 the grain boundary internal friction of ice grown from a melt was measured by cutting blocks containing individual crystal boundaries from polycrystalline ice and inlaying these in single crystal bars. This friction depends upon concentrated chemical impurities. In Part 3 the internal friction of glacier ice was measured in specimens from Antarctica, Greenland, and Le Conte Glacier, Canada. Distinctively different curves were obtained for the specimens. These differences can be attributed to (1) environmental conditions at the time of formation, and (2) the environmental conditions that acted on the sample from the time of formation until the time of sampling. Author

N65-27077# Naval Ordnance Test Station, China Lake, Calif. Aviation Ordnance Dept.

RADIOMETRIC BACKGROUND MEASUREMENTS OF 8 TO 14 MICRON RADIANCE

T. R. Stoner May 1965 18 p refs

(NAVWEPS-8730; NOTS-TP-3786; AD-615568)

Radiometric background measurements in the 8 to 14 micron spectral region are discussed and illustrated in graph form for ten types of ground samples measured at the Naval Ordnance Test Station. Measurements are presented in terms of effective radiance plotted as a function of time of day. The effective radiance of the sky one degree above the horizon and above an elevation angle of about 30 degrees is also given. Author

N65-27083# International Business Machines Corp., Cambridge, Mass.

ATMOSPHERIC DENSITY DETERMINATION USING THE SATELLITE ANALYSIS MONITOR PROGRAM (SAM) Final Report

A. S. Bramson and V. L. Foxworthy Dec. 1964 133 p refs (Contract AF 19(628)-4043)

(AFCRL-65-25; AD-615924)

Atmospheric densities may be computed from satellite observations by the following procedures: 1. Obtain accurate orbital elements from a differential orbit correction procedures 2. Fit each element as a function of time 3. Analyze the residuals in mean anomaly 4. Compute the rate of change of the anomalistic period 5. Derive density data by integrating Sterne's formula in which Jacchia's model atmosphere is used. This report describes a computer program which has been written to carry out the above procedures. It is believed that this program represents the first attempt at an automatic computation of atmospheric density at perigee heights in particular, and may also represent an advance in the state-of-the-art of automatic data processing in general. Author

N65-27102# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

AN INVESTIGATION OF WHITEOUT DISSIPATION TECHNIQUES Final Report

James E. Jiusto and Thomas R. Mee, Jr. Hanover, N. H.: Army Cold Regions Res. and Eng. Lab. May 1964 29 p refs

(Contract DA-11-190-ENG-100)

(CRREL-TR-148; AD-613288)

Means for modifying whiteouts in arctic regions in support of Army functions were investigated. An experimental program (1960) in Greenland demonstrated that dry ice seeding of supercooled clouds (fog) would facilitate certain operations in whiteouts. Various seeding techniques compatible with the arctic environment were subsequently studied; the techniques involved seeding from aircraft, rockets, tethered blimps and drones. A bench-model pellet maker was constructed for efficient conversion of liquid carbon dioxide to dry-ice pellets of a prescribed size. The relationships among dry-ice pellet size, pellet fall velocity and distance, cloud temperature, and number of ice crystals produced were established. With this information, favorable seeding patterns and equipment were postulated to fulfill the following objectives: 1. To maintain safe landing corridors at fixed ice cap installations. 2. To provide aircraft with an emergency landing capability over isolated terrain. 3. To facilitate certain ground operations. Author

N65-27104# Air Force Cambridge Research Labs., Bedford, Mass. Terrestrial Sciences Lab.

A COMPENDIUM OF PAPERS IN THE FIELDS OF WAVE PROPAGATION AND GEOTECHNICS PREPARED AT AFCRL DURING 1963

Owen W. Williams Dec. 1964 118 p refs *Its* Spec. Rept. No. 17

(AFCRL-64-998; AD-611268)

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N65-27107# Finnish Meteorological Office, Helsinki.
SOME INVESTIGATIONS OF AIRBORNE RADIOACTIVITY WITH A VIEW TO METEOROLOGICAL APPLICATIONS
R. Mattsson, V. A. Helminen, and C. Sucksdorff 1965 44 p refs *Its* Contribution No. 58

Measurements of natural and artificial radioactivity in Finland for the period 1960–1964 are discussed. The characteristics of some common type aerosol filters have been investigated. Measuring methods and instruments are described and a convenient counter-arrangement for the measuring of beta activity from the surface of filter samples is presented. In this arrangement two electronically quenched pancake type G-M-counters (dead time down to a.2 microseconds) are the detectors and the effect of backscattering is used to simultaneously detect possible changes in the composition of the unknown samples. The seasonal variation of the ratio *ThB:Rn* is discussed and suggested to be primarily due to variations of the ground water level. Author

N65-27112# Joint Publications Research Service, Washington, D. C.
DISTRIBUTION OF PARALLEL- AND MERIDIAN AVERAGED CHARACTERISTICS OF EDDIES, TEMPERATURE ADVECTION, AND GEOSTROPHIC WIND COMPONENTS OVER THE NORTHERN HEMISPHERE
N. V. Stolypina 23 Jun. 1965 10 p refs Transl. into ENGLISH from Tr. Nauchn. Issled. Inst. Aeroklimatologii (Leningrad), no. 28, 1964 p 89–95
(JPRS-30750; TT-65-31311) CFSTI: $1.00

The distribution of mean monthly values for eddies, the temperature advection, and latitudinal and meridianal components of the geostrophic wind over the Northern Hemisphere at sea level and at an absolute topography of 500 mb, during January and July for the 1954–1958 period, are considered. Synoptic data processed by computer lead to the following conclusions. Mean monthly values of the meridianal component of the geostrophic wind and temperature advection display great differences, whereas the values of the eddy and the latitudinal component of the geostrophic wind hardly change. It is noted that in the seasonal change from winter to summer, eddy values decrease in the latitude distribution while increasing in the meridianal distribution. L.S.

N65-27113# Joint Publications Research Service, Washington, D. C.
DISTRIBUTION OF THE KINETIC ENERGY OF THE GEOSTROPHIC WIND OVER THE NORTHERN HEMISPHERE AT SEA LEVEL AND AT THE 500 MB LEVEL
G. V. Leonova 23 Jun. 1965 20 p refs Transl. into ENGLISH frolm Tr. Nauchn. Issled. Inst. Aeroklimatologii (Leningrad), no. 28, 1964 p 96–111
(JPRS-30751; TT-65-31312) CFSTI: $1.00

A method of computing the kinetic energy of the geostrophic wind by means of punched-card computers are described, and the distribution of mean values of the kinetic energy, at sea level and at the 500 mb isobaric surface level, over the northern hemisphere (from 80 to 40-20° north latitude) during the central months (January, April, July, and October) of seasons of the 1954–1958 period, was analyzed from synoptic data. A grid of equivalent squares was superimposed on the map of the northern hemisphere, which was divided up into nine latitudinal belts, and the grid was used in conjunction with synoptic data. Calculations are performed, and isobaric maps showing the kinetic energy distribution are given. L.S.

N65-27122# Gt. Brit. Dept. of Scientific and Industrial Research. Radio and Space Research Station.
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA
[1965] 48 p *Its* Issue 7

Observations made at Malta between October 1 and December 10, 1964, are reported for 16 satellites. Listings are made of time, azimuth, and elevation. M.W.R.

N65-27125# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COSMIC RESEARCH, VOLUME 3, NO. 2, 1965
L. I. Sedov, ed. 20 May 1965 291 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 3, no. 2, 1965 p 179–345
(FTD-TT-65-414/1+2; AD-615433)

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16. PROPAGATION OF RADIO WAVES IN A MOVING SPACE PLASMA M. A. Gintsburg p 275–279 refs (See N65-27141 16-07)

N65-27126 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF THE COEFFICIENTS OF THE EQUATIONS OF PERTURBED MOTION OF A SOLID BODY WITH CAVITIES PARTLY FILLED WITH LIQUID

B. I. Rabinovich, L. V. Dokuchayev, and Z. M. Polyakova *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 1–41 refs (See N65-27125 16-13)

The subject is the solution of boundary-value problems related to oscillations of an ideal liquid that partly fills moving cavities of various configurations. The principal objects of interest are calculation of the hydrodynamic coefficients with an accuracy specified in advance and comparative analysis of the results obtained by various methods. Certain numerical results for cylindrical cavities with radial and coaxial partitions and for spherical, toroidal and conical cavities are presented by way of illustration. Author

N65-27127 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AN EXPERIMENTAL INVESTIGATION OF PERTURBED MOTION OF A SOLID BODY WITH CAVITIES PARTLY FILLED WITH LIQUID

G. N. Mikishev, Ye. A. Nevskaya, I. M. Mel'nikova, and N. Ya. Dorozhkin *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 42–62 refs (See N65-27125 16-13)

The possibilities of experimental studies, based on the use of mechanical (physical) models, to solve certain problems of the dynamics of a solid body having cavities partly filled with liquid are examined in this paper. An elaborated experimental method for determining the hydrodynamic coefficients of the perturbed-motion equations is set forth. Experimentally derived dimensionless hydrodynamic coefficients are given for cavities in the form of a circular cylinder, a sphere and a torus, and these values are compared with the theoretical results. Author

N65-27128 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE MOTION OF PARTICLES OF VARIOUS ENERGIES IN A ROTATING MAGNETOSPHERE

V. P. Shabanskiy *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 63–80 refs (See N65-27125 16-13)

The actual mechanism by which the lines of force of the terrestrial magnetic field are modified and the motion of particles of various energies, with consideration of the rotation of the magnetosphere is discussed. A discussion is also presented on the possibility of the existence of captured radiation in the tail of the magnetosphere. N.E.A.

N65-27129 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON MEASUREMENT OF THE X-, Y- AND Z-COMPONENTS OF THE GEOMAGNETIC FIELD ON SATELLITES AND ROCKETS

A. D. Shevnin *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 81–90 refs (See N65-27125 16-13)

The possibilities of measuring the X-, Y- and Z-components of the geomagnetic field on satellites with triaxial and uniaxial orientation relative to the center of the earth and on unoriented vehicles are examined. Author

N65-27132 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SEASONAL VARIATIONS IN THE THERMAL RADIATION FIELD OF THE EARTH AND ATMOSPHERE IN THE INFRARED REGION OF THE SPECTRUM (BASED ON MEASUREMENTS FROM GEOPHYSICAL BALLOONS IN 1962–1963)

M. N. Markov, Ya. I. Merson, and M. R. Shamilev *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 144–169 refs (See N65-27125 16-13)

Results of an investigation of the thermal-radiation field of the earth and atmosphere are described, the investigation having been conducted by a method involving the measurement of the angular distribution with equipment carried aloft in geophysical balloons to a height of 29 km. Experimental data are presented on the absolute magnitude of this radiation as well as data on seasonal variations in the shape of the angular-distribution curve for this radiation. Attention is drawn to the lack of agreement between experimental data and theoretical calculations. Author

N65-27133 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STUDIES OF THE BRIGHTNESS OF THE ATMOSPHERE AT ALTITUDES OF 120–450 km

A. Ya. Mikirov *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 170–191 refs (See N65-27125 16-13)

The results of measurement of the sky energy brightness made during daytime geophysical rocket launchings in the region of the spectrum from 3200 to 3800 A are presented. The data obtained indicate that, beginning at an altitude of 120 km, the brightness of the sunlit atmosphere diminishes monotically, reaching $1.5 \cdot 10^{-10}$ watt·cm^{-2}·ster^{-1}·μ^{-1} at an altitude of about 450 km. Comparison of the measured brightness values with calculations for an absolutely clean atmosphere indicates the presence of a large excess of daytime sky energy brightness. On the assumption that the excessive atmospheric glow is due

to aerosol scattering of light, the aerosol scattering coefficient and the density of the scattering substance are estimated in this study. Author

N65-27134 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACCOUNTING FOR VARIABILITY IN THE COEFFICIENT OF AERODYNAMIC RESISTANCE IN DETERMINING ATMOSPHERIC DENSITY ON THE BASIS OF ARTIFICIAL-SATELLITE DECELERATION
M. N. Izakov *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 192–212 refs (See N65-27125 16-13)

A computation is presented for the relationship between the coefficient of the aerodynamic resistance of a satellite and the stream parameters with consideration of available data on the structure of the atmosphere and the interaction of gas molecules with the surface of the swept body. An attempt is made with consideration of this relationship to refine the data on the density and molecular temperature of the upper atmosphere. Author

N65-27139 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IONOSPHERIC WINDS AND FEATURES OF CHARGED-PARTICLE DISTRIBUTION IN THE GEOMAGNETIC FIELD
V. I. Krasovskiy *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 259–264 refs (See N65-27125 16-13)

Relying on the analysis of satellite-orbit evolution, King-Hele assumes that there exist significant winds in the outer regions of the atmosphere at altitudes of 200 to 300 km. These winds blow toward the east, overtaking the earth in its rotation. The velocity of these winds with respect to the earth may exceed 10 cm/sec. If the King-Hele assumption is valid, the circulation of these winds affect the distribution of captured charged particles in the geomagnetic field. The features of the charged-particle distribution in the geomagnetic field as related to ionospheric winds are discussed. N.E.A.

N65-27150# Ludwig-Maximilians-Universität, Munich (West Germany). Meteorologisches Institut.
INVESTIGATION OF THE INFRARED EMISSION SPECTRUM OF THE ATMOSPHERE AND EARTH Annual Summary Scientific Report
Hans-Jürgen Bolle, Günter Kuers, Heinrich Quenzel, Werner Völker, and Adalbert Leupolt 25 Feb. 1965 86 p refs
(Contract AF 61(052)-778)
(AFCRL-65-268; AD-615527)

Comparisons between sky emission measurements in the window region of 4.7μ, and transmission measurements over a path length of about 350 m with emissivities and transmissivities calculated from the transmission data of PLASS, STULL and WYATT indicate that the theoretical data have to be corrected by a factor of 0.2–0.4. Scattered solar radiation could not be indicated in the sky emission spectrum at 4.7μ by a comparison of day- and nighttime measurements. Extinction coefficients have been derived from interference filter actinograph measurements, and have been used in an investigation about the continuum absorption in the near infrared windows. Further developments in the construction of a helicopter radiometer for measurements of the scattered solar radiation are reported. Author

N65-27190# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
SUNSPOT CYCLE AND IONOSPHERIC STORMS
Raymond J. Cormier and K. L. Smallwood Feb. 1965 42 p refs *Its* Environmental Research Papers No. 88
(AFCRL-65-125; AD-615111)

This study pertains to ionospheric storms and to the F_2 region electron density and nondeviative absorption variations accompanying them. Data for a year of medium (1960) and a year of low (1963) sunspot number are analyzed. An index of ionospheric storminess, which is an indicator of the amount of expansion and contraction of the HF useful frequency spectrum caused by ionospheric storms, is also discussed. The data used in this study are the amplitude recordings, made at Concord, Mass., of several WWV frequencies originating from Beltsville, Maryland. The path length involved is 590 km. This paper discusses: the usefulness and ease of calculation of the storm index; the apparent solar (cos x) control of the F_2 region during a year of low sunspot number; the absorption (mostly nondeviative) accompanying ionospheric and magnetic storms; the differences in average ionospheric storm variations between two years of the sunspot cycle; and the appearance or disappearance of a pronounced f_0F_1 cusp on the Ft. Belvoir ionosonde data which indicates whether an ionospheric storm is accompanied by enhanced or depressed F_2 region electron densities. Author

N65-27192# Boston Univ., Mass.
MULTIFREQUENCY OBSERVATIONS OF EXTREMELY LOW FREQUENCY ELECTRO-MAGNETIC RADIATION Scientific Report No. 2
Alan H. Katz Mar. 1965 66 p refs *Its* Astronomical Contrib. Series II, No. 39
(Contract AF 19(628)-2350)
(AFCRL-65-118; AD-615972)

Multifrequency observations of naturally occurring EM Radiation at ELF have been made at Sagamore Hill Radio Observatory, Hamilton, Mass. for the past three years. Some results of these measurements have been compared with similar ones made at Kiruna, Sweden. From July 1963 to Aug. 1964 continuous recordings of 8 cps EM radiation has been made at Sagamore Hill. A distinct diurnal variation of high nighttime to low daytime level was observed for this period. It is shown that the observed diurnal variation can be correlated with thunderstorm activity. Observations made during the eclipse of July 20, 1963 showed that a return to high nighttime level occurred during the eclipse. Measurements of EM radiation for frequency range 10 cps to 10 kc/s are compared for Sagamore Hill and Kiruna (Kiruna is located in the Auroral zone.) Also measurements of N-S and E-W components of 5 kc/s radiation for November, December, and January of 1963–1964 were made at Sagamore Hill. And from Jan. 1962 to March 1963 continuous recordings of 18 kc/s from a transmitter located at lat. 8° 57'N and long. 70° 34'W were made at Sagamore Hill. Author

N65-27195# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
STUDIES AND EXPERIMENTAL INVESTIGATION OF SPACE CHARGE MEASUREMENT EQUIPMENT Final Report, 1 Sep. 1962–28 Feb. 1965
Robert A. Fluegge and Roland J. Pilie 28 Feb. 1965 92 p refs
(Contract AF 19(628)-1680)
(CAL-RM-1751-P-1; AFCRL-65-209; AD-615456)

Airborne instrumentation was developed to measure the electrical charge on individual raindrops; simultaneous drop size measurement can be correlated to each charge determination. The equipment is sensitive to charges ranging from $\pm 1.5 \times 10^8$ to $\pm 2.5 \times 10^9$ electronic charges on raindrops having diameters larger than 250μ. A self calibrating, servo-controlled disdrometer is incorporated to insure that size and charge determinations are performed using drops that have not approached any solid surface. Author

N65-27196# Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.

ATMOSPHERIC STRUCTURE AND CIRCULATION TO 200 KM IN TERMS OF DENSITY Final Report, 1 Jun. 1962–28 Feb. 1965

V. S. Whitehead, A. M. Lencer, D. R. Harper, and W. J. Saucier Mar. 1965 86 p refs

(Contract AF 19(628)-489)

(ARL-1357-5; AFCRL-65-242; AD-615571)

Synoptic charts of pressure, temperature, and density as determined by the wind field have been prepared to 56 km altitude. These charts indicate that synoptic scale perturbations similar in extent to those found in the troposphere and lower stratosphere exist to at least up to that height. Mean monthly meridional cross-sections of density distribution as determined by the wind field are given to 80 km altitude. These cross sections depict well the known lower level features of the density distribution and suggest an orderly change in the mesospheric density pattern as the seasons progress. Diurnal and semidiurnal oscillations of isopycnic surfaces at 20N, 30N, and 40N for summer and for winter are given to 80 km. The amplitude of the diurnal wave appears to increase rapidly above 50 km with the phase shifting eastward with height to 80 km. Three atmospheric models are presented in which absorption of solar radiant energy and the downward conduction of heat are the only heat transfer processes. These models were intended to simulate, to some extent, the atmosphere between 90 and 200 km. Discrepancies between the three models, however, discourage their use for their intended purpose, but do suggest methods for developing improved models. Author

N65-27197# Utah Univ., Salt Lake City. Dept. of Geophysics.

A STUDY OF PS CONVERTED WAVES Final Report, Oct. 1961–Mar. 1965

Kenneth L. Cook and John K. Costain 30 Apr. 1965 194 p refs *Its* Contrib. No. 60

(Contract AF 19(628-201; ARPA Order 180-16; Proj. Vela Uniform)

(AFCRL-65-258; AD-615474)

Various converted waves, such as PPS and SPS, were consistently observed on seismograms at approximately correct central distances of 200 to 500 km from underground nuclear explosions detonated at the Nevada test site. Other P-like phases, such as SPP, P_MP, (or $\bar{P}$), a reflection from the base of the crust (or guided wave in the crust), were also identified. The P_MP (or $\bar{P}$) arrival was consistently a large-amplitude event for all epicentral distances. Theoretical energy and amplitude ratios were computed from the Zoeppritz equations and Knott's energy equations for both incident P and incident SV waves. Seismograms obtained from announced underground nuclear explosions at the Nevada test site (NTS) and probable Soviet underground explosions were recorded at Dugway, Utah, and showed a striking consistency of the early body-wave phases from some underground explosions in the same area. This striking consistency was used successfully for the positive detection and identification of certain underground nuclear explosions detonated at NTS and recorded at Dugway. The following phases were tentatively identified: $P_{III}P$ and/or PPPPPPP, SSPPP, SSPSS, $P_{II}P$, (or $\bar{P}$) and/or PPP, PPS, SPP, SPS; and $\bar{P}'$ (or multiple P reflection). PS converted waves were apparently generated at the 25- and/or 72-km-depth boundaries. Author

N65-27216# Joint Publications Research Service, Washington, D. C.

SEASONAL CHANGES OF THE TEMPERATURE FIELD IN THE LOWER STRATOSPHERE OVER THE NORTHERN HEMISPHERE

I. V. Khanevskaya 23 Jun. 1965 32 p refs Transl. into ENGLISH from Tr. Nauchn. Issled. Inst. Aeroklimatologii (Leningrad), no. 28, 1964 p 3–27

(JPRS-30748; TT-65-31309) CFSTI: $2.00

The temperature field changes in the lower stratosphere over the Northern Hemisphere during the year, as well as certain specific features of intraseasonal changes are examined. It is shown that the reconstruction of the temperature field from winter to summer and from summer to winter occurs in the order of one month, because of the sharp temperatures over the Polar basin. The summer and winter seasons in the stratosphere are of longer duration than in the troposphere. A specific interrelationship and succession was established in the development of the winter Pacific Ocean and summer circumpolar regions of heat. Also, the territory of the Northern Hemisphere was divided into regions with respect to the character of yearly changes of the temperature at the level of 10 millibars. E.E.B.

N65-27218# Joint Publications Research Service, Washington, D. C.

SOME PATTERNS OF SEISMIC DISLOCATIONS IN THE FAR EAST

V. N. Aver'yanova 21 Jun. 1965 30 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), no. 5, May 1965 p 93–114

(JPRS-30710; TT-65-31277) CFSTI: $2.00

The results of a study of the dynamic parameters of foci for 402 earthquakes in the Far East occurring from 1933 to 1963 with $M \geq 5$ at a depth from 10 to 600 km are given. It was concluded that: (1) The principle characteristics of the tectonic process within the limits of the Kurile–Kamchatka seismically active zone were manifested in a horizontal and deep distribution of regions with a predominance of ascending and descending movements in north-northeasterly and southwesterly directions. (2) At a depth of about 50 km there is a clear transition from predominantly fault-displacement to upthrust-displacements. (3) The surface of the mantle and the earth's crust underlying the continental slope of the oceanic depression and in certain places emerging beyond the trench in the direction of the ocean are under the influence of almost horizontal tensile stresses of a submeridional direction. E.E.B.

N65-27262 Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.

HEAT TRANSFER BETWEEN SINGLE PARTICLES AND VARIOUS FLUIDS IN RELATIVE FORCED CONVECTION

T. Tsubouchi and H. Masuda *In its* Rept. of the Inst. of High Speed Mech. [1965] p 119–135 refs Presented at 40th Gen. Meeting of Japan Soc. of Mech. Engr., 2 Apr. 1963 (See N65-27256 16-12)

(Rept.-156)

In the present paper, the authors have measured the heat transfer coefficients between small particles and flowing liquids of different Prandtl numbers to clarify the effect of Prandtl number upon the heat transfer rates, and obtained the experimental formula as follows.

$$N_{u(L)} - N_{u.0(L)} = KR_{e(L)}{}^{m}P_r{}^{1/3}$$

where, $K = 0.25$ and $m = 1/3$, for the range of $R_{e(L)} = 6 \times 10^{-4} \sim 0.2$ and $R_{e(L)}{}^{1/3}\,P_r{}^{1/3} = 0.4 - 12$; $K = 0.33$ and $m = 1/2$, for the range of $R_{e(L)} = 0.2 \sim 800$ and $R_{e(L)}{}^{1/2}\,P_r{}^{1/3} = 0.4 - 27$; in which L = 2 (volume)/(surface area) and $N_{u.0(L)}$ = limiting Nusselt number. Author

N65-27269# Joint Publications Research Service, Washington, D. C.
GRAVITY STUDY, ASTRONOMICAL SOCIETY PLENUM, AND ITS FIRST LAUREATES
23 Jun. 1965 24 p Transl. into ENGLISH from Zemlya i Vselennaya (USSR), v. 1, no. 2, Mar.–Apr. 1965 p 7–13, 74–75, 78–80 (JPRS-30757: TT-65-31318) CFSTI: $1.00

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3. THE FIRST LAUREATES OF THE PRIZES OF THE ALL-UNION ASTRONOMIC AND GEODETIC SOCIETY M. M. Dagayev p 16–20

N65-27270 Joint Publications Research Service, Washington, D. C.
DOES GRAVITY CHANGE IN TIME?
Yu. D. Bulanzhe *In its* Gravity Study, Astron. Soc. Plenum, and Its First Laureates 23 Jun. 1965 p 1–12 (See N65-27269 16-13) CFSTI: $1.00

A discussion of hypotheses on variations in the magnitude (force) of gravity in time, and an analysis of experimental gravimeter and pendulum measurements over the last hundred years at various points on the earth's surface is presented and reviewed. Periodic tidal variations in the force of gravity exist. They reach their maximum magnitude of the order of 0.5 mgl, at the equator, and their magnitude decreases and becomes negligible at the poles. A variation in the force of gravity of the order of 0.5 mgl, caused by physical processes preceding the eruption of a volcano, was noted and reliably measured. An increase in the force of gravity at Riga and Leningrad by 0.6 mgl in 10 years was fixed, but the data need checking and confirmation. No experimental data exist which could confirm the hypothesis of possible secular variations in the force of gravity in time (the hypothesis of the expanding earth). Modern apparatus and methods of measurement have not been able to observe any screening of gravitational forces. L.S.

N65-27275# Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
LOW TEMPERATURE SCIENCE. SERIES A: PHYSICAL SCIENCES
1965 211 p refs In JAPANESE; ENGLISH summaries

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10. SNOW AVALANCHE AT FURUBIRA, SHAKOTAN PENNINSULA, HOKKAIDO Tosio Huzioka, Hiromu Shimizu, Eizi Akitaya, Eiki Narita, Yosio Suzuki et al p 129–136

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13. THERMAL PROPERTIES OF SEA ICE. I: MEASUREMENTS OF THE THERMAL CONDUCTIVITY OF YOUNG WINTER ICE N. Ono p 167–176 refs (See N65-27278 16-13)

14. THERMAL PROPERTIES OF SEA ICE. II: A METHOD FOR DETERMINING THE K/$c\rho$-VALUE OF A NON-HOMOGENEOUS ICE SHEET N. Ono p 177–183 refs (See N65-27279 16-13)

15. SCATTERING OF SNOW DENSITY IN THE TOP LAYERS OF SNOW COVER UNDER MELTING CONDITIONS Kenji Kojima and Daiji Kobayashi p 185–190 refs

N65-27276 Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
A METHOD OF DETERMINING THE LIGHT SCATTERING COEFFICIENT AND THE LIGHT ABSORPTION COEFFICIENT OF DEPOSITED SNOW
Hirobumi Oura and Daij Kobayashi *In its* Low Temp. Sci. 1965 p 87–98 refs in JAPANESE; ENGLISH summary (See N65-27275 16-13)

An annual observation of snow accumulation, its properties, and change in properties is reported. Snow temperature was measured, snow stratigraphy observed, and the vertical distribution of density, hardness, and free water content was measured with reference to the stratification. Samples from characteristic layers were used to study the texture of the layers. Data from the observations are tabulated. R.N.A.

N65-27277 Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
STUDIES OF THE MECHANICAL PROPERTIES OF SEA ICE. VIII: MEASUREMENT OF FLEXURAL STRENGTH in situ (2)
Tadashi Tabata and Kazuo Fujino *In its* Low Temp. Sci. 1965 p 157–166 refs In JAPANESE; ENGLISH summary (See N65-27275 16-13)

The flexural strength of a cantilever sea ice beam was measured. The beam width was 30 to 40 cm and the length 1.5 m. An 8 to 10 cm beam 1 m long was also tested. Both upward and downward forces were applied. The bending force was applied manually with a vertical wooden lever attached to the horizontal lever, measured with an electric load-cell, and recorded with an oscillograph. The acceleration of the bending was also measured with an accelerometer placed on the free end of the beam. The beams were not considered to be elastic because no recovery was observed in the deflected beam when the force was removed. It was concluded that the flexural strength of sea ice beams increases with increasing rate of tensile stress because Young's modulus increases with increasing rate of tensile stress. R.N.A.

N65-27278 Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
THERMAL PROPERTIES OF SEA ICE. I: MEASUREMENTS OF THE THERMAL CONDUCTIVITY OF YOUNG WINTER ICE
Nobuo Ono *In its* Low Temp. Sci. 1965 p 167–176 refs In JAPANESE; ENGLISH summary (See N65-27275 16-13)

A study on the thermal conductivity of young winter sea ice is presented. Ice cover temperature and ice surface heat flow were measured. To obtain stationary temperature distribution within the ice cover, the temperature of the ice cover was artificially controlled with warm and cold tubs. Relative values for thermal conductivity were computed from the stationary temperature profiles and are shown. Thermal conductivity of the ice covers was found to change with depth and has a tendency to decrease with increasing chlorine content. R.N.A.

N65-27279 Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
THERMAL PROPERTIES OF SEA ICE. II: A METHOD FOR DETERMINING THE K/$c\rho$-VALUE OF A NON-HOMOGENEOUS ICE SHEET
Nabuo Ono *In its* Low Temp. Sci. 1965 p 177–183 refs In JAPANESE; ENGLISH summary (See N65-27275 16-13)

It was previously shown that young winter sea ice is non-homogeneous with respect to thermal properties. The differential equation of thermal diffusion is $c\rho\ \delta\theta/\delta t = \delta K/\delta z\ \delta\theta/\delta z + K\ \delta^2\theta/\delta z^2$ where c is specific heat, ρ is density, K is thermal conductivity, θ is temperature, t is time, and z is depth in the ice cover. A method is presented for determining the numerical value for K/$c\rho$ of such an ice sheet from the observed temperature data. Also, records of observations of temperature minimums are given and the values of K/$c\rho$ are calculated for these temperatures. E.E.B.

N65-27293*# Stanford Research Inst., Menlo Park, Calif.
A MODEL FOR COMPUTING INFRARED TRANSMISSION THROUGH ATMOSPHERIC WATER VAPOR AND CARBON DIOXIDE
Paul A. Davis and William Viezee [1964] 26 p refs Submitted for Publication
(Contract NAS5-2919)
(NASA-CR-63481) CFSTI: HC $2.00/MF $0.50 CSCL 20F

Analytical expressions are developed for the direct computation of infrared transmission as a function of the amount, pressure, and temperature of the absorber. The parameters that are necessary for the application of the expressions are tabulated over the wave number range between 25 and 2150 per centimeter (400 to 4.65 microns in wavelength) in intervals of 25 per centimeter. Comparisons are made between the computed transmissions and corresponding transmissions that have been presented in recent literature. Author

N65-27322# California Univ., Berkeley. Inst. of Engineering Research.
INTENSE EXPLOSIONS AT THE AIR–WATER INTERFACE I: THEORETICAL APPROACH
Richard Collins and Maurice Holt Oct. 1964 33 p refs
(Contract Nonr-222(79))
(AS-64-14; AD-615173)

The problem of a point explosion detonated at the interface between two different media, for example, at the ocean surface, is formulated. It is proposed to solve the problem by considering a linear perturbation of the similarity solutions developed for a point explosion in the spherically symmetric case. Author

N65-27439 Joint Publications Research Service, Washington, D. C.
LET US TALK ABOUT GEOMAGNETIC MEASUREMENT
Chia I *In its* Transl. on Communist China's Sci. and Technol., No. 189 22 Jun. 1965 p 22–24 Transl. into ENGLISH from K'o-hsueh Hsiao-pao (Peiping), 7 Feb. 1965 p 4 (See N65-27436 16-04) CFSTI: $2.00

On the basis of geomagnetic measurements taken 6,000 meters above sea level in Tibet, a discussion of the progressive development of geomagnetism as a science in China is presented. Considered are inherent problems associated with measuring magnetic declination, magnetic inclination, and the horizontal component intensity, of the earth's magnetic field. Speculation is made concerning the usefulness of geomagnetic data to aeronautical and national defense activities, and industrial production. S.C.W.

N65-27441 Joint Publications Research Service, Washington, D. C.
EXPERIMENT ON PENETRATION OF RADIO WAVES IN MINE TUNNELS
Shih-kuang Shu, Miao-li Hsu, Hsiao-ch'ang Ma, and Ch'en T'ao *In its* Transl. on Communist China's Sci. and Technol. 24 Jun. 1965 p 1–14 refs Transl. into ENGLISH from Ti Ch'hu Wu li Hsueh-pao (Peiping), v. 13, no. 3, Sep. 1964 p 234–242 (See N65-27440 16-34) CFSTI: $1.00

Radio wave penetration in the tunnels of a metal mine is evaluated. The wave penetration experiment was performed in a mining area whose principle minerals are lead and zinc sulfide ore, mixed with dolomite rock with resistivity between 1000 and 3000 ohm-meters. A small portable power transmitter and a portable receiver with ordinary sensitivity was used. Penetration reached an effective working distance of 100 to 240 meters. It was found that radio waves can penetrate through the rock layers separating the tunnels. The results show that when there is a great difference between the electrical properties of native rocks and the ore bodies in the mine area, and when the interference due to man-made conductors is small, radio wave shadows can be formed beyond the transmitter, and the effect due to water-filled fissure zones can be distinguished. J.M.D.

N65-27442# Joint Publications Research Service, Washington, D. C.
STUDIES IN AURORAS
M. I. Fradkin, ed. 24 Jun. 1965 65 p refs Transl. into ENGLISH from the book "Geo-i Geoliofizicheskiye Effekty v Kosmicheskikh Luchak i Polyarnykh Sinyaniyakh" Moscow, "Nauka" Publishing House, 1964 p 96–136
(JPRS-30780; TT-65-31332) CFSTI: $3.00

CONTENTS:

1. SOME CHARACTERISTICS OF AURORAS AS A RADAR TARGET AND THE CONSIDERATION OF IONOSPHERIC AND TROPOSPHERIC CONDITIONS IN THE INTERPRETATION OF RESULTS OF RADIO OBSERVATIONS Ye. F. Vershinin p 1–17 refs (See N65-27443 16-13)
2. INFLUENCE OF SEA CURRENTS ON THE DYNAMICS OF AURORAS Ye. A. Ponomarev p 18–26 refs (See N65-27444 16-13)
3. INFLUENCE OF CHARACTERISTICS OF THE OPTICAL SYSTEM OF C-180 CAMERAS ON DETERMINATION OF THE BRIGHTNESS AND POSITION OF AURORAS Yu. A. Nadubovich p 27–52 refs (See N65-27445 16-14)
4. SOME FEATURES OF THE S-180-S SPECTRAL CAMERA G. V. Starkov p 53–62 refs (See N65-27446 16-14)

N65-27443 Joint Publications Research Service, Washington, D. C.
SOME CHARACTERISTICS OF AURORAS AS A RADAR TARGET AND THE CONSIDERATION OF IONOSPHERIC AND TROPOSPHERIC CONDITIONS IN THE INTERPRETATION OF RESULTS OF RADIO OBSERVATIONS
Ye. F. Vershinin *In its* Studies in Auroras 24 Jun. 1965 p 1-17 refs (See N65-27442 16-13) CFSTI: $3.00

Analysis of the influence of refraction on the path of a radio beam during radar sounding of auroras suggests that quasi-mirror reflection from regions with high ionization density is the most important mechanism of auroral radio reflections. The lifetime of auroral inhomogeneities in the E layer of the ionosphere, effective scatter surface and interference fading of an echo signal, radio beam refraction on the path between the radar set and reflection region, and rotation of the polarization plane were studied. J.M.D.

N65-27444 Joint Publications Research Service, Washington, D. C.
INFLUENCE OF SEA CURRENTS ON THE DYNAMICS OF AURORAS
Ye. A. Ponomarev *In its* Studies in Auroras 24 Jun. 1965 p 18-26 refs (See N65-27442 16-13) CFSTI: $3.00

The bending of auroras around the shoreline of the sea is investigated. The theoretical framework is an idealized system of currents in a shallow circular sea with a stipulated bottom relief. Equations are derived for the vector potential of the secondary magnetic field induced by currents in the sea, and for the magnetic field of sea currents. These equations are applied to experimental data. It was found that the shore effect in auroras will be manifested only when the energy distribution of the currents has a maximum near some moderately high frequency, and that the mutual magnetic energy of sea and ionospheric currents will constitute a substantial part of the total energy of the aurora. J.M.D.

N65-27450# Joint Publications Research Service, Washington, D. C.
STUDIES IN SEISMOLOGICAL PHENOMENA
7 Jun. 1965 110 p refs Transl. into ENGLISH from Byul. Soveta po Seysmologii (Moscow), no. 15, 1963 p 11-24, 47-71, 95-100, 112-128, 139-145, 168-173
(JPRS-30457; TT-65-31181) CFSTI: $4.00

CONTENTS:

1. INVESTIGATION OF THE SHADOW ZONE WITH MODELS OF THE EARTH'S CRUST AND UPPER MANTLE Yu. V. Riznichenko and O. G. Shamina p 1-20 refs (See N65-27451 16-13)

2. THE POSSIBILITY OF THE INFLUENCE OF SOLAR ACTIVITY ON THE EARTH'S SEISMICITY A. D. Sytinskiy p 21-29 refs (See N65-27452 16-13)

3. SOME RESULTS OF WAVEGUIDE STUDIES ON MODELS V. V. Khorosheva p 30-40 refs (See N65-27453 16-13)

4. DETECTION OF HETEROGENEITIES IN THE STRUCTURE OF THE EARTH'S MANTLE USING TRAVEL-TIME CURVES OF DIRECT SEISMIC WAVES G. N. Bugayevskiy p 41-56 refs (See N65-27454 16-13)

5. CLASSIFICATION OF STRUCTURES OF THE EARTH'S CRUST USING SEISMIC DATA I. P. Kosminskaya p 57-66 refs (See N65-27455 16-13)

6. STRUCTURE OF THE EARTH'S CRUST AND A TRAVEL-TIME CURVE OF THE NORTHEASTERN PART OF THE BALTIC SHIELD G. D. Panasenko p 67-89 refs (See N65-27456 16-13)

7. EXPERIENCE IN USING INSTRUMENTAL METHODS OF SEISMOGRAM ANALYSIS D. P. Kirnos, Yu. A. Kolesnikov, and A. V. Rykov p 90-98 refs (See N65-27457 16-13)

8. AUTOMATIC RECORDING OF LOCAL EARTHQUAKES USING A GENERAL RADIO TIME SIGNAL G. N. Korostin p 99-106 (See N65-27458 16-13)

N65-27451 Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF THE SHADOW ZONE WITH MODELS OF THE EARTH'S CRUST AND UPPER MANTLE
Yu. V. Riznichenko and O. G. Shamina *In its* Studies in Seismological Phenomena 7 Jun. 1965 p 1-20 refs (See N65-27450 16-13) CFSTI: $4.00

Reported is a quantitative study which focuses on the problem of the law of distribution of seismic velocities and emphasizes the problem of the absence or presence of an asthenospheric channel of low velocities in the earth's upper mantle. Presented are results of model investigations of the kinematic and dynamic aspects of wave patterns in the shadow zone, which exaggerate the wave velocity gradients. Laboratory models of a medium with positive gradient, a negative gradient, and a model of a medium with a waveguide, were constructed. Considered in the analysis is the phenomenon of the seismic shadow in earthquakes. Included are comparative data from previous theoretical studies of seismic body waves. S.C.W.

N65-27452 Joint Publications Research Service, Washington, D. C.
THE POSSIBILITY OF THE INFLUENCE OF SOLAR ACTIVITY ON THE EARTH'S SEISMICITY
A. D. Sytinskiy *In its* Studies in Seismological Phenomena 7 Jun. 1965 p 21-29 refs (See N65-27450 16-13) CFSTI: $4.00

Presented is a study on the influence of solar activity on the earth's tectonic movements. Based on geophysical data in support of the assumption that the influence of solar activity on tectonic processes could occur through changes of the angular velocity of the earth's rotation, the following postulations were drawn: (1) solar activity is manifested in seismic phenomena as a triggering mechanism for release of stresses already accumulating in the earth's crust; (2) the influence of solar activity on seismic phenomena occurs through some planetary mechanism, and observed changes of angular velocity are the planetary mechanisms involved; (3) earthquakes have a direct relationship to solar activity and owe their origin to rapidly transpiring processes apparently associated with jumplike changes of angular velocity caused by solar processes; and (4) it is possible to predict, on the basis of seismic data, not only the year of the highest seismic activity on the earth, but also to determine the days of development of the strongest (with $M \simeq 6$ and above) earthquakes. S.C.W.

N65-27453 Joint Publications Research Service, Washington, D. C.
SOME RESULTS OF WAVEGUIDE STUDIES ON MODELS
V. V. Khorosheva *In its* Studies in Seismological Phenomena 7 Jun. 1965 p 30-40 refs (See N65-27450 16-13) CFSTI: $4.00

Assuming that with the passage of seismic waves along the low-velocity layer (waveguide), there will be a refracted wave or wave radiated by the walls of the layer which is observed beyond the limits of this layer; a study is made, using ultrasonic modeling, to determine whether this radiated wave

possesses adequate energy at the earth's surface to be recorded. Investigated were a source on the axis of the waveguide, and a source outside the layer. It was demonstrated that at the earth's surface it is possible to record waves radiated by the subcrustal waveguide in those regions where the depth of the waveguide is 0.5 the length of the P_s wave. It is possible to obtain recordings not only of earthquakes with foci in the waveguide, but also from earthquakes whose foci are located beyond the boundaries of the waveguide layer. When applying the results to the earth, it is surmised that the attenuation of the waveguide wave emerging from the layer will occur more slowly with increasing distance from the boundary than in the model. For this reason, recordings of the earth's seismic energy emanating from the waveguide is possible at waveguide depths exceeding 0.5 the length of the P_s wave. S.C.W.

N65-27454 Joint Publications Research Service, Washington, D. C.

DETECTION OF HETEROGENEITIES IN THE STRUCTURE OF THE EARTH'S MANTLE USING TRAVEL-TIME CURVES OF DIRECT SEISMIC WAVES

G. N. Bugayevskiy *In its* Studies in Seismological Phenomena 7 Jun. 1965 p 41–56 refs (See N65-27450 16-13) CFSTI: $4.00

Proposed is a method for empirically determining seismic wave travel-time curves which focuses on approximations of overlapping sections of the curves by parabolas of the second order. Presented is an analysis of existing theories concerning the internal structure of the earth which emphasize the dependence of the velocity of propagation of elastic body waves on depth. Included are results of computer approximations which demonstrate the accuracy of the method. S.C.W.

N65-27455 Joint Publications Research Service, Washington, D. C.

CLASSIFICATION OF STRUCTURES OF THE EARTH'S CRUST USING SEISMIC DATA

I. P. Kosminskaya *In its* Studies in Seismological Phenomena 7 Jun. 1965 p 57–66 refs (See N65-27450 16-13) CFSTI: $4.00

Using key seismic cross sections data, an approach to the classification of the earth's crust is proposed, which focuses on the systematization of data on the velocity structure of the crust and the relief forms of deep discontinuities. In the proposed classification scheme, each crustal layer is separated according to the presence or absence of the following principal velocity layers: sedimentary (velocity less than 5 km/sec), granite (velocity approximately 6 km/sec), and basalt (velocity approximately 6.5 to 7.0 km/sec). Four types of crust are recognized: continental, in which all three velocity layers are usually found; oceanic, which has no layer with a velocity of 6 km/sec; intermediate, which is almost entirely oceanic in composition; and subcontinental, which differs from all preceding types in that its consolidated crust is represented by a layer with a velocity somewhat greater than 6 km/sec and somewhat less than 6.5 km/sec. Also considered are criteria which can be used with seismic data to define structures of higher orders. S.C.W.

N65-27456 Joint Publications Research Service, Washington, D. C.

STRUCTURE OF THE EARTH'S CRUST AND A TRAVEL-TIME CURVE OF THE NORTHEASTERN PART OF THE BALTIC SHIELD

G. D. Panasenko *In its* Studies in Seismological Phenomena 7 Jun. 1965 p 67–89 refs (See N65-27450 16-13) CFSTI: $4.00

On the basis of an analysis of seismic data on two earthquakes which occurred in the northeastern part of the Baltic shield in 1960, and an analysis of several records of industrial explosions; a concept of the structure of the earth's crust in this area was obtained, from which the travel time curve of the seismic waves as derived. Although travel-time data was in satisfactory agreement with seismic data, results are regarded as preliminary pending further refinements. New determinations of previous investigations confirm the presence of significant discrepancies in the total thickness of the earth's crust and the velocities of propagation of seismic waves in the subcrustal layer for regions of the Kola Peninsula, northern Karelia, and northern Finland. The derived discrepancies are believed to be a reflection of the block structure of the earth's crust in the northeastern part of the Baltic shield. S.C.W.

N65-27457 Joint Publications Research Service, Washington, D. C.

EXPERIENCE IN USING INSTRUMENTAL METHODS OF SEISMOGRAM ANALYSIS

D. P. Kirnos, Yu. A. Kolesnikov, and A. V. Rykov *In its* Studies in Seismological Phenomena 7 Jun. 1965 p 90–98 refs (See N65-27450 16-13) CFSTI: $4.00

The feasibility of using instrumentation methods in processing and analyzing seismograms in the laboratory is discussed. Described are newly developed instrumentation for converting visible records into an electric current, and an analytical apparatus for recording the amplitude spectra of seismic oscillations. Results of an analysis of instrumentally determined earthquake spectra are included. S.C.W.

N65-27458 Joint Publications Research Service, Washington, D. C.

AUTOMATIC RECORDING OF LOCAL EARTHQUAKES USING A GENERAL RADIO TIME SIGNAL

G. N. Korostin *In its* Studies in Seismological Phenomena 7 Jun. 1965 p 99–106 (See N65-27450 16-13) CFSTI: $4.00

Described is an automatic system for recording local earthquakes which consists of several earthquake recording stations and a time marking station. Presented are data on the arrangement of the recording station, the principle components of the time marking station, the circuitry of the automatic control apparatus, and the technical-economic indices of the system. S.C.W.

N65-27460# Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station

THE NUMERICAL CALCULATION OF WAVE-FIELDS, REFLEXION COEFFICIENTS AND POLARIZATIONS FOR LONG RADIO WAVES IN THE LOWER ATMOSPHERE

W. R. Piggott, M. L. V. Pitteway, and E. V. Thrane London, Royal Society [1965] 53 p refs *Its* Phil. Trans. of the Roy. Soc. of London, Ser. A, Vol. 257, No. 1079, 11 Mar. 1965 p 219–271

CONTENTS:

1. THE NUMERICAL CALCULATION OF WAVE-FIELDS, REFLEXION COEFFICIENTS AND POLARIZATIONS FOR LONG RADIO WAVES IN THE LOWER IONOSPHERE, PART I M. L. V. Pitteway p 219–241 refs (See N65-27461 16-13)

2. THE NUMERICAL CALCULATION OF WAVE-FIELDS, REFLEXION COEFFICIENTS AND POLARIZATIONS FOR LONG RADIO WAVES IN THE LOWER IONOSPHERE, PART II W. R. Piggott, M. L. V. Pitteway, and E. V. Thrane p 243–271 refs (See N65-27462 16-13)

N65-27461# Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station.
THE NUMERICAL CALCULATION OF WAVE-FIELDS, REFLEXION COEFFICIENTS AND POLAHIZATIONS FOR LONG RADIO WAVES IN THE LOWER IONOSPHERE, PART I
M. L. U. Pitteway *In its* Numerical Calculation of Wave-Fields, Reflexion Coefficients and Polarizations for Long Radio Waves in the Lower Ionosphere [1965] p 219–241 refs (See N65-27460 16-13)

The wave-fields inside a horizontally stratified ionosphere produced by a radio wave incident at any angle from below are calculated by integrating the governing differential equations. An improved method of obtaining two independent solutions of these equations is described in some detail. For the first solution, the polarization of the wave incident on to the ionosphere from below is chosen so that no energy is propagated to great heights; the second solution has the incident polarization chosen to maximize this energy. In each case, a complex reflexion coefficient is derived from the relative amplitude and phases of the upgoing and downgoing waves in free space below the ionosphere, and the polarizations of the downgoing wave are also studied. The method which is usable on a small computer, is applicable for any angles of incidence, azimuth and dip, and for any height variation of the model ionosphere. Author

N65-27462# Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station.
THE NUMERICAL CALCULATION OF WAVE-FIELDS, REFLEXION COEFFICIENTS AND POLARIZATION FOR LONG RADIO WAVES IN THE LOWER IONOSPHERE, PART II
W. R. Piggott, M. L. V. Pitteway, and E. V. Thrane *In its* Numerical Calculation of Wave-Fields, Reflexion Coefficients and Polarizations for Long Radio Waves in the Lower Ionosphere [1965] p 243–271 refs (See N65-27460 16-13)

The characteristics of radio waves of low and very low frequency reflected from numerical models of electron density and collision frequency are calculated. The models used are based on those found by cross-modulation experiments and approximate to those likely to be found in the ionosphere. The effects of changing the models are investigated with the object of developing methods of solving the inverse problem of deducing the ionization structure from the experimental data on long and very long wave propagation. The relations between the computed and observed characteristics are examined in a preliminary way. Author

N65-27514*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIROS VII RADIATION DATA CATALOG AND USER'S MANUAL, VOLUME 2, OCTOBER 1, 1963–FEBRUARY 29, 1964
Musa Halev Pasternak, ed. 31 Dec. 1964 205 p refs
(NASA-CR-63652) CFSTI: HC $6.00/MF $1.25 CSCL 04A

This volume contains time-dependent information concerning radiometer response patterns, possible corrections for instrumental degradation, the Index of Final Meteorological Radiation Tapes, and Subpoint Tract Summaries. The data from the channels throughout the period covered by this volume are of value for studies involving the relative measurements over a short period of time, for example, mapping of cloud systems. N.E.A.

N65-27537# Rhode Island Univ., Kingston. Dept. of Electrical Engineering.
LABORATORY MODEL OF THE EARTH–IONOSPHERE CAVITY Final Report (Part II), 15 Jun. 1960–14 Jan. 1965
I. P. Yu, R. James, and C. Polk 15 Mar. 1965 47 p refs
(Contract AF 19(604)7252)
(URI-7252/4; AFCRL-65-200(II); AD-614619)

The theory of electromagnetic scaling is outlined for media in which the scalar electric conductivity and dielectric permittivity are either constants or functions of position. This theory is applied to the construction of a scale model of the earth-isotropic ionosphere cavity. Construction of the cavity is described. Effects upon field distribution due to eccentricity between the two shells in a perfectly conducting resonator of the earth-ionosphere dimensions are considered; it is found that correction terms due to eccentricity have a magnitude not greater than approximately one per cent of the unperturbed fields everywhere except in those regions where the unperturbed fields approach zero. Author

N65-27636# Geophysics Corp. of America, Bedford, Mass. Technology Div.
RESEARCH DIRECTED TOWARD DEVELOPMENT OF MORE ACCURATE MODEL ATMOSPHERES WITHIN THE ALTITUDE RANGE 90 KM TO 700 KM AND PREPARATION OF MODEL ATMOSPHERE PUBLICATIONS Final Report
Raymond A. Minzner Nov. 1964 118 p refs
(Contract AF 19(628)-1633)
(GCA-TR-64-14-A; AFCRL-64-944; AD-615019)

Studies concerning various aspects of atmospheric model generation are reported. Six scientific reports are reviewed in the light of the objectives of and their contribution to the general field of atmospheric model development. Each report is summarized with abstract, table of contents, and reference lists attached. Author

N65-27650# RAND Corp., Santa Monica, Calif.
THE TRANSMISSION OF GEOMAGNETIC MICROPULSATIONS THROUGH THE IONOSPHERE AND LOWER EXOSPHERE
E. C. Field and C. Greifinger Apr. 1965 44 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-4494-ARPA; AD-615164)

The propagation of hydromagnetic waves at altitudes below 2000 km is considered. The approximations used to describe hydromagnetic wave propagation in the ionosphere and exosphere, involves vertical polar propagation, and representations of the ionosphere by a constant Alfven speed and locally exponential ion collision frequency, and of the lower exosphere by a collisionless region with an Alfven speed which increases exponentially with height. The region above the lower exosphere is treated as having a uniform Alfven speed. By using this model it was possible to case the ionospheric and exospheric wave equations into forms which are solvable in terms of known functions. An analytic, polar propagation model has yielded readily interpretable results which agree with experiment in the following manner: A strong double daytime and strong nighttime resonance was obtained, and the computed nocturnal prominence of the exospheric Pc 1 and 2 resonances agreed with the measured diurnal behavior of certain classes of micropulsations. The ability to take simple limiting cases of analytic expressions has provided physical insight with regard to the transmission and reflection processes. R.W.H.

N65-27656# Army Electronics Labs., Fort Monmouth, N. J. Meteorological Div.
ATMOSPHERIC ATTENUATION OF LIGHT RADIATION FROM A POINT SOURCE IN AN ARCTIC ENVIRONMENT
Israel Cantor and Andrew Petriw Oct. 1964 134 p refs
(ECOM-2453; AD-615023)

Twenty-two nighttime measurements were made of the atmospheric effects on light attenuation from a point source

during the spring and fall of 1962 at a site on the Greenland icecap (Camp Century) located at 77° 10'N and 61° 08'W at an elevation of 6800 feet above sea level. The Arctic environment provided an ideal surface albedo of almost unity, while the additional presence of clouds provided "duct effect," or energy-trapping, situations. Graphs are included to show the total and indirect intensity fluctuations over 12-second intervals under various atmospheric conditions. Some comparison is also made of the ratio of indirect/direct intensity vs optical depth under some Arctic and New Jersey shore atmospheric conditions. A much greater indirect/direct ratio in an Arctic environment of almost unity albedo, as compared to a local New Jersey environment of about 0.2 and 0.5 for the total albedo, is evident from some of the results noted. Results also indicate that intensities of light pulses from a point light source can vary by more than 100 percent at distances of 4.5 miles over 20-second time intervals. Author

N65-27664# Joint Publications Research Service, Washington, D. C.

BIBLIOGRAPHY OF SOVIET PUBLICATIONS ON ROCKET AND SATELLITE INVESTIGATIONS OF THE UPPER ATMOSPHERE AND OUTER SPACE IN 1964

2 Jul. 1965 28 p refs Transl. into ENGLISH of the Russian bibliography of a report presented to COSPAR 8th Meeting, Buenos Aires, May 1965 "Investigations of the Upper Atmosphere and Outer Space Carried Out in the USSR in 1964" p 82–117

(JPRS-30925; TT-65-31424)

N65-27688*# National Aeronautics and Space Administration, Washington, D. C.

GEODETIC JUNCTION OF FRANCE AND NORTH AFRICA BY SYNCHRONIZED PHOTOGRAPHS TAKEN FROM THE ECHO I SATELLITE [LA JONCTION GEODESIQUE FRANCE AFRIQUE DU NORD PAR PHOTOGRAPHIES SYNCHRONES DU SATELLITE ECHO I]

H. M. Dufour Jun. 1965 17 p Transl. into ENGLISH from the Proc. of the Symp. de Géodésie par Satellites, Inst. Géograph. Natl. (France), Dec. 1964 14 p

(NASA-TT-F-9388) CFSTI: HC $1.00/MF $0.50 CSCL 08E

General characteristics of the France-North African geodetic junction groundworks, instrumentation used, preparation for observations, plate processing, and computation programs are described. About sixty positions of the Echo I satellite were selected to be photographed, and the successful photos are tabulated. The problem was to interpolate the position of flashes from the satellite. Theoretical star coordinates on the photographic plate were calculated, and the plates were observed with a comparator. Calculations were made for formulas giving the directing cosines of the flashes in the terrestrial cartesian system, for unknown coordinates of the stations starting from known coordinates, and for intersection of the flashes starting from the approximate coordinates of the stations. L.S.

N65-27703*# National Aeronautics and Space Administration, Washington, D. C.

ESTIMATE OF THE DECREASE OF THE S FIELD WITH ALTITUDE [ESTIMATION DE LA DECROISSANCE EN ALTITUDE DU CHAMP S]

P. N. Maynaud Jul. 1965 27 p refs Transl. into ENGLISH of Note No. 3 of Inst. de Phys. du Globe, Paris, Jul. 1964

(NASA-TT-F-9406) CFSTI: HC $2.00/MF $0.50 CSCL 08N

A theoretical study to estimate the altitude effects of the field S caused by diurnal variation is presented in detail. The study is based on a plane model consisting of two layers of circular currents whose centers are 7000 km apart, in an attempt to approximate the results that would be obtained from a rigorous spherical harmonic analysis. A plane is passed perpendicularly through the centers to study the effects of the field S in the vicinity of the noon meridian. The density of currents in each layer is varied along the equator according to a parabolic law. The quality of approximation in using a plane model is considered. J.M.D.

N65-27707*# National Aeronautics and Space Administration, Washington, D. C.

ANALYSIS CENTER OF GEOPHYSICAL DATA OF IONOSPHERIC RESEARCH GROUP [CENTRE DE DEPOUILLEMENT DE DONNEES GEOPHYSIQUES DU GROUPE DE RECHERCHES IONOSPHERIQUES]

L. R. O. Storey Jun. 1965 4 p Transl. into ENGLISH from Rech. Spatiale (France), v. 4, no. 5, 1965 p 39–41

(NASA-TT-F-9421) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Equipment used in the Analysis Center of geophysical data is described. The installation was conceived to analyze data recorded on magnetic tape, and to treat photographic data. The laboratory equipment consists of registering devices, a rapid galvanometric oscillograph with multiple tracks for presenting data in oscillogram form, sonic spectrographs, and an analogical numerical converter cable. Plans were made to install a spectral force calculator, a numerical analyzer of instantaneous phases of sinusoidal waves at variable frequency, a rapid curve tracer, and a large cathode oscilloscope with numerical control that gives a visual presentation of numerical data. In all of the apparatus, logical operation and unrolling of sequences is controlled by a small PDP-5 computer included in the conversion chain. In the past year, the apparatus was used mainly for analyzing atmospheric soundings and variations in the earth's magnetic field. L.S.

N65-27791# Defence Research Board, Ottawa (Ontario).

A NEW TECTONIC CHART OF THE ARCTIC

I. P. Atlasov, V. A. Vakar, V. D. Dibner, B. Kh. Yegiazarov, A. B. Zimkin et al Aug. 1964 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 156, no. 6, 1964 p 1341–1342

(T-412-R; AD-610386)

The development of structural complexes, stratigraphic levels and sub-levels at different ages, formed under different tectonic conditions, is presented graphically in schematized form. The tectonic structures of the continent, the continental shelf, and the ocean floor are depicted in terms of a single system of conventional signs and in closely detailed contours. Petrographic and paleontological studies of coarse detrital material collected from the marginal floors of the Arctic waters were conducted for this purpose. The area where the crust is of the continental type is divided into fold systems, recent geosynclines, and parageosynclines; these three divisions are further subdivided according to their geological development. In regions with oceanic-type crust, the chart shows such tectonomagnetic neostructures as mid-oceanic ridges, oceanic troughs, and island arcs. M.W.R.

N65-27802# Army Engineer Research and Development Labs., Fort Belvoir, Va. Scientific and Technical Information Branch.

TECHNIQUES OF REVISING TOPOGRAPHIC MAPS

A. M. Abol'yan and Z. I. Tolmacheva [1964] 6 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 7, 1964 p 52–55

(T-1767; AD-610477)

A method is recommended for revising maps of flat regions when it is possible to rectify the aerial photographs for a single zone. This method uses a transparent deformation-resistant

plastic as the original for correcting maps. When the plastic used is more than 0.15 mm thick, an outline image of the map is generally obtained on the mat side of the transparent base by relief method or by offset printing. When copies are made by the relief method, it is recommended that the mat side of the plastic be coated with a lacquer to eliminate shadow-formation on the copies. When plastics of less than 0.15 mm thickness are used, the outline copy should be made on the polished side of the plastic in mirror-image form. Both the relief and ordinary staining method can be used in this case. M.W.R.

N65-27815*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DETERMINATION OF MEAN ATMOSPHERIC DENSITIES FROM THE EXPLORER IX SATELLITE
Gerald M. Keating, James A. Mullins, Claude W. Coffee, and Donald S. Mc Dougal Washington, NASA, Jul. 1965 35 p refs (NASA-TN-D-2895) CFSTI: HC $2.00/MF $0.50 CSCL 04A

A method is developed for determining mean atmospheric densities from changes in the orbital elements of the Explorer IX (1961 Delta 1) satellite, a 12-foot-diameter balloon. The decay of the total energy of the satellite orbiting about an oblate spheroid is evaluated and the energy change due to the work done by radiation force upon the satellite is subtracted to yield the energy decay attributed to atmospheric drag. The direct solar radiation force upon Explorer IX is determined from measured vectorial reflectances of the satellite material. Equations are given for the effective coefficient of drag of Explorer IX, and mean atmospheric densities at heights from 310 km to 765 km are tabulated for the entire lifetime of the satellite (February 1961 through March 1964) from changes in the orbital elements of Explorer IX. Author

N65-27838# Lowell Technological Inst. Research Foundation, Mass.
IONOSPHERIC RESEARCH USING AN AIRBORNE SYSTEM Final Report, 1 Sep. 1962–31 Dec. 1964
Klaus Bibl, Charles Pike, Jackie Waaramaa, and Rosemarie Wagner Feb. 1965 54 p refs
(Contract AF 19(628)-1682)
(AFCRL-65-189; AD-616107)

Possibilities and limitations in ionospheric research with an aircraft as carrier are described; the experiments comprise LF and HF pulse sounding, VLF reception, and magnetometer recordings. The mobility of the Flying Laboratory permits observation of the rare and strong events in the ionosphere which are caused by solar eclipses and eruptions as well as topographic anomalies, auroras and artificial nuclear tests. The observations of these phenomena and special measurements of ionospheric drift, of deviative and nondeviative absorption, and of reflection height made the development of special recording and playback methods necessary. Ray paths of the different possible modes arriving at an airplane are derived. Author

N65-27850# Air Force Cambridge Research Labs. Bedford, Mass. Meteorology Lab.
STRATOSPHERIC ENERGY PROCESSES AND ASSOCIATED ATMOSPHERIC LONG-WAVE STRUCTURE IN WINTER
H. Stuart Muench Apr. 1965 129 p refs *Its* Environ. Res. Papers No. 95
(AFCRL-65-236; AD-616124)

The question of the source of energy for the changes in the mid-winter stratosphere circulation pattern associated with the sudden warming phenomenon is examined. A set of energy equations is derived which is applicable to the stratosphere as an open system. The terms of these equations are interpreted as representing energy conversions and energy fluxes. The terms are evaluated for January 1958, for the mass from 100 mb to 10 mb and from 10N to 90N. Within the mass studied, the energy conversions acted in the same direction throughout the month, but increased in magnitude prior to and during the stratosphere warming. Energy was lost due to differential diabetic heating but was gained, at the expense of tropospheric energy, through a correlation between vertical velocity and geopotential. The apparent coupling with the troposphere is investigated further through harmonic analysis and evidence is found for vertically propagating long waves. A simple model is deduced from the data to explain certain phenomena in the stratosphere. Author

N65-27851# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
THE EQUATORIAL AIRGLOW
S. M. Silverman Apr. 1965 22 p refs *Its* AF Surveys in Geophys., no. 162
(ATCRL-65-280; AD-616244)

Published data on the equatorial airglow are critically reviewed. A number of new results, based primarily on data collected during the IGY, are presented for the oxygen green line and the sodium line. It is shown that the diurnal variation of the green line in equatorial regions is markedly different from that in temperate latitudes. Author

N65-27902# Army Engineer Research and Development Labs., Fort Belvoir, Va. Scientific and Technical Information Branch.
ESTIMATION OF THE ACCURACY OF THE ELEMENTS OF AN ASTRONOMO-GEODETIC NETWORK COMPOSED OF POLYGON LINKS
A. Sh. Tatevyan [1964] 13 p refs Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 6, 1964
(T-1763; AD-610474)

Errors in the starting azimuths are considered in examining the accuracy of an astronomo-geodetic network composed of polygon links. The sides with the starting azimuths are differently arranged, and three types of links can be distinguished. Formulas for computing the transverse displacement and the longitudinal error for each link are given, and the mean square errors of the adjusted angles are determined. Equations are also given for calculating the true errors of the increases of coordinates for the links forming the polygon, and the total discrepancy of the polygon with respect to the coordinate axes are computed. It was concluded that an increase in the frequency of the azimuths does not lead to a marked increase in the mean square error of the adjusted angle; however, the mean square discrepancy of the polygon is appreciably reduced with an increase in the frequency of the azimuths. M.G.J.

N65-27908# Canterbury Univ., Christchurch (New Zealand). Physics Dept.
STUDIES OF THE LOWER IONOSPHERE Final Report
J. B. Gregory 5 Oct. 1964 50 p refs
(Contract Nonr-2651(00))
(AD-610507)

Pulsed radio wave studies of the lower ionosphere in polar and temperate latitudes are reported. Experimental results suggest that major factors have been omitted in the current theory of the lower ionosphere. It was found that electrical properties of this region are strongly influenced by dynamic aspects of ionospheric circulation. In polar latitudes the influence of corpuscular radiation, though variable over the sun spot cycle, appears at times to be more important than photon influx in determining electron densities. Although they are a

minor constituent of the atmosphere below 100 km, electrons are of value as tracers of a number of different processes. Particular note is made of the use of electrons as indicators of mass motion between 60 and 120 km, where other techniques of wind measurement are difficult to apply. J.M.D.

N65-27931# United Aircraft Corp., East Hartford, Conn.
THE DIAGNOSIS OF UPPER-AIR HUMIDITY FROM SURFACE OBSERVATIONS
John T. Ball, Donald A. Chisholm, Paul Luty, and Keith W. Veigas Bedford, Mass., AFSC, Electron. Systems Div., Jan. 1965 108 p refs
(Contract AF 19(628)-3437)
(ESD-TR-65-1; AD-610713)

Northern-hemisphere surface-synoptic and radiosonde data from November, 1961 through February, 1962 are used to develop diagnostic relationships between surface-observed variables at a single station and the dew-point spread at the 850-, 700-, 500-, and 400-mb levels above that station. The approach consists of two steps: (1) the isolation within a decision-tree framework of those cases for which surface-observed variables yield highly reliable estimates of upper-level humidity, and (2) the application of a statistical technique (Regression Estimation of Event Probabilities) to the remaining cases to derive equations yielding probabilities of occurrence of specified categories of dew-point spread. This approach yields useful diagnostic information of variable quality. A method of incorporating this information into an objective analysis of humidity is outlined. The results of a feasibility study assessing the value of using a network of stations to estimate upper-level humidity above a single station are given. Surface-synoptic data from a network surrounding Washington, D.C. (DCA) and radiosonde data from DCA for a forty-month period are used for the study. Author

N65-27952*# Columbia Univ., Palisades, N. Y. Lamont Geological Observatory.
RESEARCH ON QUANTITIES AND CONCENTRATIONS OF EXTRATERRESTRIAL MATTER THROUGH SAMPLINGS OF OCEAN BOTTOMS Six-Month Status Report, Sep. 1964–Feb. 1965
William A. Cassidy [1965] 19 p
(Grant NsG-232-62)
(NASA-CR-63771) CFSTI: HC $1.00/MF $0.50 CSCL 08J

Research was conducted in the areas of optical and electron microscope studies of polished sections of natural spherules, magnetic separations on ocean bottom trawling samples, nondestructive radioactivation analysis of spherules, and model studies on underwater cratering. R.N.A.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-26657# Société Suisse de Chronométrie, Neuchâtel.
INTERNATIONAL CONFERENCE ON CHRONOMETRY, VOLUME 1
[1964] 627 p refs Proc. of Conf. held in Lausanne, 1964

Chronometry conference papers are presented on the uses of quartz and electric motors. For individual titles see N65-26658–N65-26707.

N65-26658 Army Electronics Labs., Fort Monmouth, N. J.
QUARTZ CRYSTALS AND QUARTZ OSCILLATORS
G. K. Guttwein *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 29–51 refs (See N65-26657 16-14)

The development of practical atomic frequency standards and the availability of very low frequency transmissions providing accurate frequency and timing information in many parts of the world has not eliminated the importance of quartz crystal oscillators but has shifted the emphasis in their applications. Besides being used as flywheel oscillators in all atomic standards, they are still widely used as precision standards and clocks. Applications where small size combined with a minimum of power consumption and mechanical ruggedness are decisive factors, have gained importance during the last years. Modern developments of quartz crystal units suitable for use in precision crystal oscillators and clocks are shown. Important properties such as temperature characteristic, frequency drive dependence and aging behaviour are discussed. The effect of environmental conditions such as vibration, acceleration, and nuclear radiation is considered. To obtain optimum frequency stability these crystal characteristics have to be taken into account in the design of oscillators. Author

N65-26659 Bell Telephone Labs., Inc., Murray Hill, N. J.
FUNDAMENTAL STUDIES OF AGING IN QUARTZ RESONATORS
A. W. Warner, D. B. Fraser, and C. D. Stockbridge *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 53–69 refs (See N65-26657 16-14)

An intensive study into the structure of quartz, along with examination of the role of sorption phenomena and thermally induced strains, are directed toward the goal of a non-aging quartz crystal, i.e., the production of a crystal unit whose frequency change with time is less than its short time stability of a few parts in 10^{11}. Changes in the concentration of impurities, particularly of alkali ions, have been shown to alter the frequency determining parameters of the quartz. Specially designed vacuum furnaces are used for the introduction, removal, and analysis of such impurities. Measurements of Q and frequency as a function of temperature from 1.4 to 840° K serve to correlate resonator behaviour with the change in impurity. Studies of frequency dependence on added inertial mass have been carried out by the measurement of adsorption isotherms of various gases in apparatus capable of resolving 10 picograms per square centimeter. Improvements have been made in frequency recovery following a temperature change by the use of special parallel-field electrodes. The effects on frequency of strains associated with the presence of various electrode configurations have been measured in pumped, temperature controlled enclosures at 10^{-10} torr and ±0.0001° C. The significance of the results obtained to date are discussed, and the indicated approach to an optimum crystal unit design presented. Author

N65-26660 Fernmeldetechnisches Zentralamt, Darmstadt (West Germany).
THE CORRELATION BETWEEN THE FREQUENCY OF QUARTZ OSCILLATORS AND THE HUMIDITY OF THE AIR [UEBER DIE KORRELATION ZWISCHEN DEM FREQUENZVERLAUF VON QUARZUHREN UND DER LUFTFEUCHTIGKEIT]

A. Herrmann *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 71–85 refs In GERMAN; FRENCH and ENGLISH summaries (See N65-26657 16-14)

In the experiment to be described several quartz oscillators were compared daily with standard frequencies from several time services. The tested oscillators have been in operation without interruption for 2, 5 and 7 years. The measurements have now been analysed thoroughly, the different corrections being accounted for. By means of a computer the frequency curves of 3 oscillators have been approximated by analytical functions, the differences between the measurements and the computed functions have been tabulated and compared to the humidity of air as measured in the cellar where the oscillators were installed. While the temperature in this cellar was kept constant at 20 ±1° C, the humidity fluctuated yearly between 30 and 80%. The correlation between frequency and humidity was found to be between 0.8 and 0.9, the humidity effect lagging behind by about 8 weeks due to the construction to the thermostats. The value of the frequency–humidity dependence is -20 and -15×10^{-9}/ 10% for the oscillator with a big air coil in the oscillator circuit and -5×10^{-9} / 10% for a Pierce oscillator without coil. Author

N65-26661 Compagnie Generale de Telegraphie sans Fil, Paris (France).

A LOW FREQUENCY QUARTZ FREQUENCY STANDARD WITH LOW POWER REQUIREMENT [PRESENTATION D'UN PILOTE A QUARTZ A FAIBLE CONSOMMATION POUR APPLICATIONS HORLOGERES]

Pierre Vovelle *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 87–94 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

This paper describes a low frequency quartz oscillator of the aperiodic type using a high stability quartz of 4 kc/s in a vacuum holder. The frequency is divided by multivibrators to around 50 c/s. The power supply consists of 1.5 V battery delivering less than 60 μA. The reliability of the instrument is considerable with respect to changes in temperature and in power supply voltage as well. Author

N65-26662 Lip, S. A., Besancon (France).

A MINIATURE QUARTZ CLOCK [PRESENTATION D'UNE HORLOGE A QUARTZ]

Paul George *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 95–104 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

The midget quartz clock has a 4 KH_z oscillator with dividers. The output frequency drives a small synchronous motor. The synchronous clock delivers a signal of 1 c/s. The power supply for one year is given by standard "D" batteries. The overall dimensions are smaller than 1 dm^3. The influence of voltage and temperature on frequency is reduced to reach the accuracy required by Observatory regulations for Marine Chronometers. Author

N65-26663 Ebauches, S. A., Neuchatel (Switzerland). Departement Oscilloquartz

SMALL ELECTRONIC, BATTERY-POWERED CHRONOMETER [CHRONOMETRE ELECTRONIQUE AUTONOME DE PETIT VOLUME]

Francis Berger *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1947] p 105–116 In FRENCH; GERMAN and ENGLISH summaries (See N65-26657 16-14)

The design of a quartz chronometer of small volume requires the application of special electronic circuits of high reliability and low power consumption. The chronometer consists of a LF quartz oscillator, temperature-compensated, a divider chain by pulse accumulation, a micromotor and mercury batteries sufficient for 1 year's operation. The volume is smaller than 1 liter, the precision is ±0.05 s/day in the temperature range of 4 to 36° C. Author

N65-26664 Tokyo Inst. of Tech. (Japan).

50 c/s QUARTZ CRYSTAL OSCILLATOR DRIVEN BY ESAKI OR TUNNEL DIODE

Hitohiro Fukuyo, T. Miyazato, A. Inoue, and T. Samejima *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 117–125 refs (See N65-26657 16-14)

Fukuyo has already reported on a 50 c/s Quartz Crystal Oscillator in 1958 and 1959. An interesting feature of this oscillator was a very low frequency such as 50 c/s, obtained directly with the pretty good stability of less than $\pm 1 \times 10^{-5}$/day as the result of a new design of a cantilever type special vibrator. We have still been improving not only the vibrator itself but also the oscillator circuit. This paper is concerned with an interesting oscillator circuit in which an Esaki or Tunnel Diode is used as a simple switching element in order to maintain the oscillation. For instance, we have found this oscillator has a very convenient characteristic that the frequency does almost not change even though the voltage of the source battery decreases a little. We have also been observing this oscillator for more than one year and are now satisfied very much with its reliable operation with only a small aging like 1×10^{-5}/year. Author

N65-26665 Telefonbau und Normalzeit, Frankfurt am Main (West Germany).

TIME CENTER WITH CRYSTAL CLOCKS FOR SHIPS [NEUZEITLICHE QUARZUHRENZENTRALE FUR SCHIFFE]

Karl-Ludwig Plank *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 127–137 refs In GERMAN; FRENCH and ENGLISH summaries (See N65-26657 16-14)

This time center is characterized by high precision and high reliability. Two completely independent crystal clocks with all the necessary controls feed suitable amplifiers which in turn fixed the secondary clocks. In case of a breakdown all the elements of the main clock are automatically and without loss of precision replaced by identical elements of the stand-by clock. The thermostats for the quartz are controlled electronically to ±1/100° C, the temperature can be set to the inversion point of the quartz. The long term stability is better than $\pm 1 \times 10^{-7}$ and can be improved to 3×10^{-9}. The divider divides by a factor of 20 per stage. The secondary clocks can be set individually or together in both directions. The secondary clocks are controlled by electronic means so that the precision of the quartz clocks is preserved. Author

N65-26666 Osservatorio Astronomico di Brera, Milan (Italy).

STANDARDS OF TIME AND FREQUENCY AT THE OBSERVATORY OF MILAN [ETALONS DE TEMPS ET DE FREQUENCE DU SERVICE HORAIRE DE L'OBSERVATOIRE DE MILAN]

Edoardo Proverbio *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 139–155 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

Crystal oscillators used in astronomy, geodesy and physics have usually a precision of 10^{-8} to 10^{-10}; if used as interpolation oscillators for atomic clocks, a very outstanding stability is required. The Observatory of Brera owns 4 quartz oscillators installed in a thermally controlled room (25 ±0, 1° C). The short term and long term stability have been investigated by the following methods: Comparisons of the second pulses with time signals from stations controlled by atomic frequency standards

(HBN, MSF and WWV); Phase comparisons between the oscillators and the signals from VLF standard frequency transmitters (GBR and NBA); Direct frequency comparisons among the different oscillators. The aging of the oscillators has thus been measured accurately. The short term stability was found to be of the order of 10^{-10} and the aging smaller than 10^{-10} per day. Author

N64-26667 Naval Observatory, Washington, D. C.
TIME DETERMINATION AND DISTRIBUTION: CURRENT DEVELOPMENTS AND PROBLEMS
William Markowitz *In* Soc. Suisse de Chronometrie Intern. Conf. on Chrdnometry, Vol. 1 [1964] p 157–177 refs (See N65-26657 16-14)

The PZT and astrolabe determine time (U.T.) and latitude simultaneously. Their use in the study of geophysical and geodetic problems such as the variable speed of rotation of the earth, the periodic and secular motions of the pole, and the drift of continents is discussed. Timekeeping accuracy has increased greatly due to the introduction of atomic clocks and improvements in quartz-crystal clocks. The principal time and frequency transmissions are coordinated internationally. The need for publishing large quantities of corrections to time signals and to clocks no longer exists. VLF, Loran-C, and artificial statellites such as Telstar are used to synchronize clocks and compare frequency with high precision. Variations in the speed of rotation of the earth are determined by comparing U.T. with atomic time. Observations made with the Washington and Richmond PZT's since 1955 indicate that changes in acceleration and deceleration occur but not sudden changes in speed. Author

N65-26672 Brussels Univ. (Belgium). Laboratoire des Etalons de Fréquence.
RESULTS OF RECEPTIONS OF TIME SIGNALS [RESULTATS DE RECEPTION DE SIGNAUX HORAIRES]
S. T. Haume, J-P. Bullinckx, J. De Prins, R. Detrie, and J-L. Guisset *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 229–240 ref Presented to the French Chronometric Soc., 25 Nov. 1962 In FRENCH (See N65-26657 16-14)

We describe the time-keeper mounted in our laboratory and its control with respect to time signals and calibrated frequencies received by radio transmission. We present a measurement method of the arrival-time of second pulses transmitted on V.L.F. We mention our recording of S.P.A. and their measure. Author

N65-26674 Institut für Angewandte Geodasie, Frankfurt am Main (West Germany).
PRECISE TIME KEEPING ON EXPEDITIONS [GENAUE ZEITHALTUNG AUF EXPEDITIONEN]
Karl-Wilhelm Schrick *In* Soc. Suisse of Chronometrie Intern. Conf. on Chronometry, Vol 1 [1964] p 253–260 In GERMAN; ENGLISH and FRENCH summaries (See N65-26657 16-14)

Because of their reduced volume and weight and their independence from external power sources, modern small quartz clocks can be used on expeditions instead of the conventional chronometers. They are especially convenient for astronomical determinations in undeveloped regions, where precise time keeping is required in spite of poor conditions for the reception of radio time signals. The correction of a clock with seconds contacts can be determined without any additional means by observing coincidences between the clock contacts and the radio time signals. By connecting the clock contacts in parallel with the loudspeaker circuit of the receiver, it is possible to observe the coincidences accurately. Mean time quartz clocks allow for coincidences with mean time signals at any interval using a phase shifting network in the clock. The procedure was performed and tested with a small quartz clock, set at mean time, of Messrs. Patek Philippe—"Chronotome CP" with a seconds contact and the possibility of modifying the clock correction by steps of milliseconds. The correction of the clock relative to any permanent time signal could always be eliminated within fractions of a millisecond.—The precision of time keeping during periods without reception of time signals is discussed. Author

N65-26675 Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
MEASUREMENT OF FREQUENCY AND RATE BY MEANS OF TIME INTERVALS AND VARIABLE PULSE SEQUENCIES [GANG- UND FREQUENZMESSUNG MITTELS ZEITINTERVALLEN UND VARIABLER IMPULSFOLGEN]
Udo Adelsberger *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 261–268 In GERMAN; FRENCH and ENGLISH summaries (See N65-26657 16-14)

An electronic transistorized and printing counter (9 decimal places) was developed for precisely measuring time intervals longer than 2 s in such a way that, by means of an internal storage register, no time is lost between two successive intervals (model AEG). It is possible, therefore, to achieve a continuous survey of frequency or rate values, further to automatically add 10 or 100 individual values as an exact average (printed out in red) and, by adding pulse groups, to develop a few methods of measurement based on the comparison of phase or state difference. Variable time-intervals and pulse sequences are suitable for testing the instrument, for adapting to frequencies and rates and for many other applications. Pulse sequences, if varied continuously, are also a facility for automatic measurements. A stable time base (frequency jitter $\pm 3 \times 10^{-9}$) with accessories is also described. Author

N65-26676 Institut für Angewandte Geodäesie, Frankfurt am Main (West Germany).
PERMANENT AND AUTOMATIC RECORDING OF CHRONNOMETERS CORRECTIONS [AUTOMATISCHE DAUERSTANDBESTIMMUNG VON CHRONOMETERN]
Gunther Zimmermann *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 269–275 In GERMAN; FRENCH and ENGLISH summaries (See N65-26657 16-14)

To investigate short term fluctuations of the rate of chronometers it is advisable to measure over a long period of time and at frequent intervals the time correction of the chronometer against a standard. For long runs with varying experimental conditions the following setup was found appropriated: A printing chronograph which is driven by a quartz clock (type CAA by Rohde and Schwarz) prints the time of particular seconds contacts of the chronometer under observation, the contacts being chosen appropriately and in the right sequence by a programmer. The complete setup operates automatically and needs no servicing. Details and results will be given and discussed. Author

N65-26677 Observatoire Cantonal, Neuchâtel (Switzerland).
ATOMIC CLOCKS [LES HORLOGES ATOMIQUES]
J. Bonanomi *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 277–295 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

In a first part the non-specialist in this field is given a review of the principles of operation of atomic frequency standards. Nearly all these standards use as a reference a spectral line due to the magnetic interaction of an atomic

nucleus with a valence electron (hyperfine structure separation). These spectral lines, situated in the microwave region, exhibit a frequency which is almost independent of external magnetic and electric fields. The elements at present in use are hydrogen, rubidium, cesium and thallium. The basic problem to be solved with each type (gas cell, beam resonator, maser) of atomic frequency standards, is to make the spectral line both narrow and intense. Other problems are those of design: the frequency should be independent of the design parameters (e.g. magnetic field, microwave cavity, electronic system). Finally practical requirements (volume, reliability, life-time, etc.) have to be met. A second part gives a comparison of the results achieved by means of the different types of frequency standards, whereby in addition to accuracy also other criteria are considered. The different commercial models are discussed. In a third part a few experiments and developments currently in progress in different laboratories are presented. Author

N65-26681 Hewlett-Packard Co., Palo Alto, Calif.
A MODERN SOLID-STATE PORTABLE CESIUM-BEAM STANDARD
A. S. Bagley and L. S. Cutler *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. I [1964] p 333–352 refs (See N65-26657 16-14)

A compact, solid-state cesium beam frequency standard will be described. The circuitry associated with the short beam tube is designed to be highly reliable. Size and power consumption have been kept to a minimum, and the equipment is designed to work from a 26 V d.c. power source so it may be used on a standby battery source for clock applications. The frequency synthesizer is in the main loop. The design is such that the time scale in which the output frequencies of 5 mc, 1 mc, and 0.1 mc are expressed is easily changed by replacement of a single component. Particular effort was given to the design of the synthesizer to keep the amplitude of spurious frequencies sufficiently low. Logic circuitry is provided so that proper operation is indicated by a combination of lights. In addition, metering of various circuits is provided. Absolute accuracy is $\pm 6 \times 10^{-11}$, making the standard useful as a precision clock. Author

N65-26682 Ebauches, S. A., Neuchâtel (Switzerland).
ATOMIC CLOCK USING A CESIUM TUBE [HORLOGE ATOMIQUE AVEC TUBE A CESIUM]
H. Brandenburger, J. Michel, P. Kartaschoff, and J. Racine *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 353–358 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

In this paper the following topics are discussed: the properties of a frequency and time standard using a small cesium tube; the short term frequency stability, limited by the noise of the atomic beam and by the characteristics of the fly-wheel crystal oscillator; the long term stability and the accuracy, determined by the properties of the tube and by the systematic errors of the automatic frequency control circuits; an atomic clock designed for continuous operation and containing only solid-state devices; and the obtained results. Author

N65-26686 Société Suisse de Chronométrie, Neuchâtel.
THE ELECTRIC WATCH AND CLOCK [LA MONTRE ELECTRIQUE]
Max Hetzel *In its* Intern. Conf. on Chronometry, Vol. 1 [1964] p 383–402 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

This paper gives a comprehensive general view of the state of the art in the field of electric and electronic watches and clocks. Only wristwatches will be treated in addition to a few clocks closely related to the wristwatch industry. The few wristwatch types on the market do not supply enough material to make a far-reaching investigation; the author therefore leans on the published patent literature, as it is mentioned in the "Revue des Inventions Horlogères" of the Swiss Watch Chamber and in the "Electronique Horlogère" of patent bureau "Bugnion". After a short theoretical review of the energetic aspects and the frequency stabilities for the most interesting ideas, the author will mention the difficulties which could arise while trying to make practical use of such ideas for wristwatches. The paper closes with a short view on the presumable developments in the future. Author

N65-26689 Société Anonyme des Etablissements Leon Hatot, Paris (France).
ELECTROMAGNETIC OSCILLATING DEVICES OF MEDIUM AND LOW FREQUENCY [DISPOSITIFS OSCILLATEURS ELECTROMAGNETIQUES A MOYENNES ET BASSES FREQUENCES]
Jacques Dietsch *In* Soc. Suisse Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 429–434 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

An electromagnetic oscillator was studied which consists of a particle vibrator, which is intended to eliminate the effect of gravity on the period of oscillation and to suppress the reaction characteristics of a support-mounted system. The device is set in an elastic mounting on its support. Tests revealed that the oscillator's frequency is between 50 and 1000 Hz, that it can run for a long time on a small energy supply, and that it functions with good stability in different positions. Transl. by J.M.D.

N65-26690 Besancon Univ. (France). Laboratoire de Méchanique Appliquée
THE DAMPING OF VIBRATING REED OSCILLATORS [L'AMORTISSEMENT DANS LES OSCILLATEURS A LAME DE FLEXION]
Claude Oudet *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 435–442 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

It is generally possible by simple calculations to anticipate the quality of an oscillator fairly well. It is shown that the damping spectrum, proper to the chosen material, is to be studied first, especially that part of the spectrum due to the thermal current. The spectrum of a rolled Elinvar strip is presented, as well as the method used to determine it. It can be shown that a range of frequency exists which it is not advisable to use and which accounts for many failures. External losses can also be calculated and the necessary precautions for reducing them are pointed out. In particular, the elementary conditions leading to a tuning fork are defined, as well as the performance of such an oscillator designed according to this method, which is far from being limited to the usual U shape. A particular design of a vibrating reed tuning fork is presented, which satisfies the theoretical requirements, easily achieved in small dimensions with Q-factors of 10^4. Author

N65-26691 Technische Hochschule, Dresden (East Germany).
ELECTRICAL ANALOGS OF MECHANICAL OSCILLATORS [ELEKTRISCHE ANALOGIEBETRACHTUNGEN MECHANISCHER SCHWINGER]
Woldemar Kienast *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. I [1964] p 443–456 refs In GERMAN; ENGLISH and FRENCH summaries (See N65-26657 16-14)

Since many different designs of electric watches exist, it is desirable that the conditions of the mechanical oscillator be translated into the electric case in order to arrive at an

uniform treatment based on the electric current. With this goal the equivalent electric circuit of the mostly used mechanical oscillator, namely the balance-wheel hairspring system, is derived. In doing this, the following analogies are made used of: Mechanical force—electric current and mechanical speed—voltage. In both cases the result is a parallel resonant circuit with capacitance, inductance and damping resistance. In order to connect the mechanical oscillator as a resonant electric circuit to the electric voltage, a transducer is needed which takes into account the influence of the transmission parameters. The author attempts to develop such a transducer. The study of the electrical analog leads to suggestions for the design of electric watches using the balance hairspring as a time base. Author

N65-26692 Societe Suisse de Chronométrie, Neuchâtel.
TIME INSTRUMENTS WITH INERTIA–ELASTICITY OSCILLATORS AT ACOUSTICAL FREQUENCIES [INSTRUMENTS HORARIES MUNIS D'OSCILLATEURS "INERTIE–ELASTICITE" DE FREQUENCES ACOUSTIQUES]
Marius Lavet *In its* Intern. Conf. on Chronometry, Vol. I [1964] p 457–464 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

This paper is limited to the discussion of electronic watches regulated by vibrators which need no lubricated pivots. After a short review of the properties of different mechanical oscillators (straight reeds, tuning forks, elastic rings, torsion pendulums, etc.) the author describes the advantages of an isochronous regulator consisting of 2 vibrating masses with same amplitude and opposite phases. The oscillations are sustained by means of magneto-electric organs of high efficiency. The following has been achieved: 1. a portable chronometer (3 × 3 × 0.5 cm) consisting of a free vibrator and a counter by means of a synchronised servomotor, 2. a simplified watch (1.5 × 2.5 × 0.5 cm) including the battery. The same principle applies to emitters of periodic currents which can be synchronised by very low-power radio signals. Author

N65-26693 Ebauches, S. A., Neuchâtel (Switzerland).
ELECTRONIC WATCH WITH BALANCE-HAIRSPRING SYSTEM [MONTRE ELECTRONIQUE A BALANCIER SPIRAL]
Andre Beyner and André Hug *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. I [1964] p 465–472 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

In the case of self-exciting mechanical oscillators, the conditions of excitation may have a considerable effect on the precision. Moreover, when the oscillator directly supplies the energy necessary for counting the oscillations, the methods by which counting is achieved mechanically are also essential for the maintenance of precision. Lastly, it is important that the quality factor of the oscillator should remain stable over a prolonged period of time. These are the chief considerations on which has been based the development of a wristwatch 28.0 mm in diameter, with a balance-hairspring driven by a transistorized circuit. This new caliber is also fitted with a device for showing the date through an aperture in the dial. The efficiency of the motor is high. The operational temperature range extends from −20°C to +60° C. Finally, the system is shockproof and nonmagnetic according to the international standards that are now being prepared. Author

N65-26695 Centre Electronique Horloger, S. A., Neuchâtel (Switzerland).
SYSTEMS FOR ELECTRONIC WRIST WATCHES [SYSTEMES ELECTRONIQUES POUR MONTRES-BRACELETS]
M. P. Forrer *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 479–485 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

We consider the application of systems synthesis to the problem of the electronic wrist watch. The end-objective is expressed in terms of precision, stability, reliability, simplicity, possibility of miniaturization and cost. For the purpose of this discussion the systems considered shall be battery powered and equipped with mechanical hands. Since the driving power for the hands is of the order of 0.1 microwatt, and a battery of acceptable dimensions delivers approximately 10 microwatt for at least a year, the working range from the point of view of power is determined. For the choice of the free parameters, the main problem becomes that of spending the available power in a fashion that best approaches the realization of the end-objectives. The systems study is based on the characteristics of the principal organs of the watch: the oscillator (time base), the motor driving the hands, and the electronic frequency divider. The synthesis shows that presently a relatively low oscillator frequency must be used to reduce the number of required frequency divider stages. Author

N65-26696 Besancon Univ. (France). Laboratoire de Mecanique Appliquée.
MECHANICAL TORSION OSCILLATOR [DIAPASONS DE TORSION]
Gérard Lallement *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. I [1964] p 487–501 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

The paper describes a torsion oscillator designed as a time base or a very selective filter in the frequency range of 400 to 10'000 c/s. Compared to a conventional torsion oscillator this vibrator is characterized by the following features: 1. principles of operation (vanishing kinetic moment) 2. fixation (very small active isolation factor) 3. excitation (piezo-electric). The first results achieved with such vibrators of small dimensions are very satisfactory (20'000<Q<120'000 at 4'000 c/s) and promise to yield stabilities superior to those of classical tuning forks. Finally it is emphasized that with the peculiar suspension mode of this oscillator a remarkable insensitivity to vibrations is achieved. Author

N65-26697 Centre Electronique Horloger, S. A., Neuchâtel (Switzerland).
CALCULATION OF THE POSITION ERROR OF A MECHANICAL OSCILLATOR [CALCUL DE L'ERREUR DE POSITION D'UN OSCILLATEUR MECANIQUE]
Albert Botta *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 503–514 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

The position error is one particular aspect of the general problem of mechanical oscillator systems considered for use in time-keeping devices and must be investigated before making a choice. This paper reviews some calculations concerning the frequency variations of a linear oscillator as a function of the orientation of the trajectories of the oscillating masses in the gravity field. Author

N65-26699 Reveils Bayard, S. A., Saint-Nicolas d'Aliermont (France).
DEVICE FOR CONSTANT AMPLITUDE [MICROCONTACT PERFECTIONNE ENTRETENANT LE BALANCIER SOUS AMPLITUDE CONSTANTE]
In Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 527–534 In FRENCH; ENGLISH and GERMAN summaries (See N64-26657 16-14)

This paper describes a special micro-contact for sustaining the oscillations of an oscillator and for securing a constant average amplitude in the best conditions. Every regulating device displays a departure from isochronism with variations of the amplitude. This is particularly true in a system which depends on a contact in which opening and closing are poorly defined and variable with time. The best a priori method for maintaining constant the frequency of a regulator is of course to make the amplitude of the oscillations invariable. The proposed device, even if its realisation is delicate, promises to be satisfactory when applied to electric watches and clocks of medium size. Author

N65-26700 Société Suisse de Chronométrie, Neuchâtel.
A CONSTANT SPEED TWISTING SHAFT TRANSISTOR MOTOR SUITABLE FOR TIMEPIECES
C. F. Clifford *In its* Intern. Conf. on Chronometry, Vol. 1 [1964] p 535–544 refs (See N65-26657 16-14)

The motor consists of two elements joined by a Ni Span 'D' shaft which twists under torsional forces. As the shaft revolves, one element with its permanent magnet rotor generates signal currents in its associated stator coil and these are passed through the emitter of a transistor, so releasing equivalent driving impulses through the collector and driving coil associated with the second element, which is mechanically identical with the first element. The permanent magnet rotors situated at each end of the torsion shaft provide the moment of inertia and the shaft itself the spring of this revolving mechanical oscillator whose θ position error is consequently within ±10 seconds/day by design. Author

N65-26701 Technische Hochschule Stuttgart (West Germany).
INVESTIGATIONS OF THE GRAHAM DEAD-BEAT ESCAPEMENT ON PENDULUM CLOCKS [NEUERE UNTERSUCHUNGEN AN PENDELUHREN MIT GRAHAM-HEMMUNG]
Wolfgang Finster *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 545–553 In GERMAN; ENGLISH and FRENCH summaries (See N65-26657 16-14)

The Graham dead-beat escapement is one of the oldest and best known escapements. By means of electronic computers it is possible today to analyze the operation of this escapement numerically and to optimise the performances by variation of the different parameters as: geometric design, coefficient of friction and amplitude. Furthermore it is possible with the modern tools and instruments (quartz clocks, photoelectric transducers, oscilloscopes) to measure the relative effects of the different parameters and to compare the computed and measured results. Author

N65-26702 Centre d'Etudes Scientifiques, Paris (France).
DIGITAL MAGNETIC RECORDING OF THE SIGNALS OF A CRYSTAL CLOCK [ENREGISTREMENT MAGNETIQUE DIGITAL DES SIGNAUX D'UNE HORLOGE A QUARTZ]
Jean D. Lebel *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. I [1964] p 555–562 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

Signals from a system of seismometers are evenly sampled. The numerical value of each sample is recorded on magnetic tape in binary code. Time is derived from a crystal clock. About once per second some digital characters of the magnetic tape are reserved to record to the hundredth of a second the time at which a particular sample has been gathered. At playback digital time signals reproduced from the magnetic tape, drive the crystal clock which thus displays the recording time. This feature allows an easy identification of any part of the magnetic tape by looking at the "played-back" time on the display of the crystal clock. Time correction is automatically taken into account in the computer program when digitalized time and seismic data are fed to the IBM 1620. Hence this computer analyses signals whose time of occurrence are known to it with an accuracy comprised between 0.1 and 0.05 second. Author

N65-26703 Osseruatorio Astronomica di Brera, Milan (Italy).
TIME DISTRIBUTION SERVICE AND DEVICE FOR AUTOMATIC SYNCHRONISATION OF CLOCKS [SERVICE DE DISTRIBUTION DE L'HEURE ET DISPOSITIF POUR LA REMISE A L'HEURE AUTOMATIQUE DES HORLAGES]
Giovanni Crestetto (Enrico Boselli S.p.A., Milan), Luciano Mazzon (Azienda Tranviara Municipale, Milan), and Edoardo Proverbio *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. I [1964] p 563–579 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

The problem of synchronising networks of clocks with precision and reliability is of ever increasing importance. In order to satisfy the demands of industry, city and region, the institute of chronometry of the Observatory of Brera has designed a permanent service for distribution of coded time signals for the resetting of electrical clocks by the transmission of radio signals. The transmission of the signals in the MF band is sufficiently reliable even in a region of heavy radio interference. The system achieves synchronisation one, two or three times per hour with a precision of the order of one second. The service is at present used by the tramways of Milan and by many private subscribers and will be adopted in the near future by the subways and other railways of Milan. The effeciency, precision and reliability of this service are such that an important extension is anticipated. Author

N65-26704 Telefonbau und Normalzeit, Frankfurt am Main (West Germany).
CLOCK REMOTE CONTROL [UHRENFERNSTEUERUNG]
Erich Gentsch *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 581–600 refs In GERMAN. (See N65-26657 16-14)

The following three methods for remote control of electric clocks to insure synchronization are discussed: (1) direct current remote control, (2) induction remote control, and (3) audiofrequency remote control. The audiofrequency method was found to be most feasible because it permits the multiple use of existing transmitter channels under optimal control conditions. Transl. by G.G.

N65-26705 Omega, Louis Brandt et Frère, S. A. Biel (Switzerland).
THE PHOTOSPRINT-TIMER, A PHOTOGRAPHIC CHRONOMETER [LE PHOTOSPRINT, UN CHRONOGRAPHE PHOTOGRAPHIQUE]
Francois Leu *In* Soc. Suisse de Chronometrie Intern. Conf. In Chronometry, Vol. I [1964] p 601–611 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

Applied especially to timing sports events, the Photosprint-timer registers the complete finish of a race, giving the exact position and time of each competitor. The picture is taken through a thin vertical slit; the film moves continuously at a speed corresponding to that of the runners. The time-scale, in minutes, seconds, tenths and hundredths of a second, is accomplished with an optical device driven by an electronic counter, which projects, on the centre line of the slit, the image of the numbers. This is entirely transistorised, and the high-precision quartz clock guarantees a long-term stability of the order of 10^{-7}. The fully electronic time-marking device enabled the realization of a completely transportable apparatus, weighing only 19 kg. At present the main application of the Photosprint-timer is the timing of sports events, but its use in the scientific field for the control of aperiodical movements is envisaged. Author

N65-26706 Compagnie des Montres Longines, S. A., Saint-Imier (Switzerland).
TWO TRACK PRINTING CHRONOGRAPHS ALLOWING TO APPRECIATE 1/1000th OF A SECOND BY USE OF TRANSISTORIZED ELECTRONIC DEVICE [CHRONOGRAPHE IMPRIMANT A DEUX PISTES, PERMETTANT D'APPRECIER LES MILLIEMES DE SECONDE ET UTILISANT UNE ELECTRONIQUE TRANSISTORISEE]

P. Schaller *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 613–628 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

In order to time races, where it is possible to receive simultaneously start and finish impulses, it is necessary to use 2 simple printing chronographs to time at 1/100th of a second. The printing chronograph with two tracks which is presented here, allows the measurement with only one instrument. A transistorized quartz clock has been developed to replace the electronic tubes quartz clocks built in 1954. The following main points will be discussed: 1. Mechanical means used to realize 2 tracks; 2. Quartz-oscillator; 3. Frequency divider using four-layers Shockley diodes, Circuits stability, Stability of synchronization versus temperature; 4. Power supply of the synchronous motor; 5. Comparison with the former design using electronic tubes; and 6. Performances and results. Author

N65-26707 Société Suisse de Chronometrie, Neuchâtel.
RECORDING G. M. T. IN BINARY CODE ON MAGNETIC TAPE FOR AIRCRAFT DATA RECORDING
R. A. Fell and I. A. M. Watson *In its* Intern. Conf. on Chronometry, Vol. 1 [1964] p 629–640 (See N65-26657 16-14)

G.M.T. can be reproduced from a 13 bit binary code. A series of 3 printed circuit commutator disks and 13 active wipers can translate the position of the clock hands into binary code. Change of each minute is controlled to within ±1 second by a pair of contacts. The disks are read by using the first 13 segments of a bank of the multiplexing switch in the Midas recorder, allowing the record to be made on the track allocated to digital information in an otherwise analogue system. Recovery of the information is achieved by the interrogation of storage gates on receipt of a minute change command signal. This information is then fed to a binary-decimal convertor, actuating either a visual, printing, or punched paper display. The electro-mechanical time digitiser mechanism ensures safe positioning of the hour wipers at each minute change, resolving any possible ambiguity. The precision mechanical clock fits the standard 3" aircraft instrument panel hole and provides sufficient power to drive the digitiser for over 60 hours. Chronograph and non-chronograph versions are available. Author

N65-26708# Société Suisse de Chronométrie, Neuchâtel.
INTERNATIONAL CONFERENCE ON CHRONOMETRY, VOLUME 2
[1964] 706 p refs Proc. of Conf. held in Lausanne, 1964

Chronometry conference papers are presented on regulating organs, self-winding watches, materials, quality control, and fabrication. For individual titles see N65-26709–N65-26763.

N65-26709 Besancon Univ. (France). Laboratoire de Méchanique Appliquée.
THE REGULATING ORGANS AND THEIR PROBLEMS [LES ORGANES REGLANTS ET LEURS PROBLEMES]
Raymond Chaléat *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 645–664 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The classical balance wheel–hair spring, driven by a lever escapement has achieved a remarkable precision; but, while certain technical and theoretical problems are still unsolved, new ones come up due to the improvement of the methods of measurement. The basic question appears to be the practical impossibility to realize a truly isochronous oscillator. From the experimentally determined damping curve the passive resistances can be deduced only if the restoring torque is rigorously proportional to the elongation; a systematic error is thereby introduced in the majority of the measurements of damping coefficients by the presence of a nonlinear restoring torque. Other elastic oscillators promise to acquire a great importance in chronometry. The tuning fork having been designed as a radiator of acoustical energy, will have to be reinvestigated thoroughly in view of its new application in chronometry, where interesting results have already been achieved. The bending oscillators can be substituted by torsion oscillators. Q-factors of the order of 180'000 have already been obtained and it is anticipated that torsion oscillators can be designed into portable frequency standards; this would mean that the gap between mechanical oscillators and crystal oscillators is being closed. Author

N65-26710 Fabriques d'Assortiments Réunies, Le Locle (Switzerland).
STATE OF THE ART AND FUTURE OF THE LEVER ESCAPEMENT [CONNAISSANCE ET AVENIR DE L'ECHAPPEMENT A ANCRE]
A. Simon-Vermot *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 665–685 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

After a short historical review of the development of the lever escapement, we shall examine, with the help of the newest techniques which will be described, the operation of the lever escapement in its actual shape. Two aspects will be mainly approached, on one side the variations of the efficiency as a function of different parameters such as moment of inertia, frequency of the balance-wheel, and on the other side the importance of the different materials used in the escapement, their importance being examined from the point of view of mechanical strength. A few of the most recent designs will be shown; the discussion of their performances is followed by an outlook on the future evolution of the lever escapement. Author

N65-26711 Compagnie des Montres Longines, S. A., Saint-Imier (Switzerland).
RATIONALIZATION IN FIXING AND CENTERING THE HAIRSPRING [VIROLES SYSTEME BERTHOUD]
Marc E. Nardin and Claude Ray *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 687–699 *In* FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

One of the main bottlenecks in the assembly line is often the traditional operation of fixing the hairspring. In order to mechanize these operations a method proposed by Louis William Berthoud was adopted. After breaking the hook of the hairspring, the latter is placed freely between two collets of a special shape previously assembled. The hairsprings with collets are then placed on a projector in order to allow with the help of a reference drawing, scale 50:1, a perfect centering of the system. The projector is so designed that one can then squeeze the blade of the balance-spring between the two collets in order to obtain a rigid setting. The obtained results are excellent from the point of view of centering and flatness of the balance-spring. Movements with balances fitted with this combination can be compared with the same movements equipped with balances pinned up traditionally with pinning point. The comparisons presented depend also on a dynamic poising of the balance wheel-hairspring. Author

N65-26712 Fabriques d' Assortiments Reunies, Le Locle (Switzerland). Laboratoire de Recherches Appliquées.
ACTUAL STATE OF OUR RESEARCH EFFORTS FOR AN IMPROVED LEVER ESCAPEMENT [ETAT ACTUEL DE NOS RECHERCHES POUR L'AMELIORATION DE L'ECHAPPEMENT A ANCRE]

E. Favre and A. Simon-Vermot *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 701–712 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

After a few remarks on the difficulties and disadvantages of the present escapement lubrication method, we shall mention two directions taken by the research done in this field. New materials will be discussed, which promise to overcome some of the present drawbacks of show other interesting properties. Among others, ceramic materials will be considered and their composition and properties compared to those of ruby and spinel. A new method of lubrication will be shown, which, as borne out by the results of several experiments, is directly adaptable to the classic materials, steel-ruby and brass-spinel. Author

N65-26713 Technische Hochschule, Dresden (East Germany).
MODERN METHODS OF POISING BALANCE WHEELS [MODERNG STATISCHE AUSWUCHTVERFAHREN FUR UNRUHEN]
S. Hildebrand *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 713–723 refs In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

The watch and its technology are submitted to requirements no longer satisfied by customary poising methods. A particular disadvantage stems from the fact that the moment of inertia is uncontrollably changed during poising, that the quality of poising is limited by the precision of setting to the center of gravity and that the result depends on the care of the operator. The author analyses several procedures with 4 equal additions to the moment of inertia, the addition being in the form of drilled holes. The order in which the holes are drilled and their position has an important effect. Compared to a known procedure, the additions to the moment of inertia can be kept about 4 times smaller with equal quality of poising: the quality of poising is defined as the ratio of the statistically maximum error to the maximum tolerated error. Author

N65-26714 Les Fabriques de Balanciers Réunies, S. A., Biel (Switzerland).
INERTIOMETER AND BALANCE-INERTIA COMPARATOR [INERTIOMETRE ET COMPARATEUR D'INERTIE POUR BALANCIERS]
Rolf Tièche and Hugues Vaucher *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 725–734 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

In order to be able to measure quickly and without recourse to the complicated calculation often required, the moment of inertia of a balance, an apparatus known as the "Inertiometer" has been developed. It operates according to the principle of the modification of the rate of a known oscillating system by the addition of the balance which is to be measured. Thanks to extensive experiments and measurements by means of this apparatus on a large number of currently used balances, it has become possible to restrict the variety of dimensions peculiar to each case and to set up standards with the moment of inertia as operational basis. Furthermore, by extension, the principle of the Inertiometer has led to the development of a balance-inertia comparator which ensures the measurement of very small differences of inertia and by mechanical and electronic means, the sorting of balances according to their moment of inertia. For this one, the balances which are to be compared, are mechanically coupled with another oscillator and the resulting period is measured by a timing unit. It thus becomes possible to supply customers with balances with a precisely specified moment of inertia. Author

N65-26715 Besancon Univ. (France). Laboratoire de Méchanique Appliquée.
A THEORETICAL AND EXPERIMENTAL STUDY OF THE MEASUREMENT OF AMPLITUDE AND DAMPING BY MEANS OF THE OSCILLATING WATCH [ETUDE THEORETIQUE ET EXPERIMENTALE DU PROCEDE DE MESURE DE L'AMPLITUDE ET DE L'AMORTISSEMENT PAR LE DISPOSITIF DE MONTRE OSCILLANTE]
Raymond Chaléat, Francois Oudard, and Roger Plancon *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 735–757 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The device of the oscillating watch has been used systematically for measuring the amplitudes of the balance wheel and of the damping. The process requires laying the watch on a platform which is suspended by means of a torsional filament or a bi-filar suspension and then measuring the successive amplitudes of the platform. A theoretical study shows that the damping has only a second order effect on the period of the coupled system, and that the coupling always increases the damping of the balance wheel. In the coupled state, the damping coefficients are strongly variable. The ratio of the amplitudes is independent of the damping coefficients to the second order. It increases with the ratio of the fundamental frequencies. It is shown that the coupling coefficient does not intervene in practice, that the damping of the secondary has to be moderate and that the beats that are characteristic of the transient regime, can be reduced by remaining sufficiently far away from resonance. The above results have been verified experimentally. The amplitude of the balance wheel can be deduced from that of the platform only if the two oscillators, which make up the coupled system, have good isochronism. Author

N65-26716 Centre Technique de l'Industrie Horlogere, Besancon (France).
THE RENUMBERING OF THE HAIRSPRINGS [JUSTIFICATION DES MODIFICATIONS DE LA NUMEROTATION DES SPIRAUX]
Andre Donat *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 759–763 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

When in 1930-31 the hairsprings were attributed numbers according the C.G.S.-system, the "standard numbers", as they were then in use, were adopted to a large extent. The committee ISO TC 19, the international body which is responsible for fixing the "standard numbers", has since issued new rounding-off rules which lead values slightly different from the theoretical ones. The latter ones cannot be used anyway since they are given to at least 5 significant figures. Given the new rules of the committee ISO it appears that the numbers used for hairsprings for the last 30 years should be adapted to the new values. This perturbs only a few numbers and affects only the designation but not the values of the torque. It is mentioned in this context that at the end of the last war, the numbering had been extended to include large hairsprings up to C.G.S. 2360 and that the inversion of the present needs had called for an extension down to C.G.S. 0.0100. Author

N65-26717 Bueren Watch Co., S. A., (West Germany).
SOURCE AND TRANSMISSION OF THE ENERGY IN MECHANICAL WRIST WATCHES [SOURCE ET TRANSMISSION DE L'ENERGIE DANS LA MONTRE-BRACELET MECANIQUE–LA MONTRE AUTOMATIQUE]
H. Kocher *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 765–782 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The selfwinding watch may be considered as the final development in the field of mechanical wrist watches. It will serve us as example in our study of the transmission of the energy, from the wearer, to the balance wheel. We shall sum-up our knowledge of the movements of the arm as a source of energy. The energy transducers, such as receiver, rectifier and gear trains, are closely analysed. The conditions for maximum winding speed will be determined, and suggestions will be made for standardizing the efficiency tests on selfwinding watches. Author

N65-26718 Institut Straumann, A. G., Waldenburg (East Germany).
MAIN-SPRINGS AND HAIRSPRINGS [RESSORTS ET SPIRAUX]
Samuel Steinemann *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 783–797 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The main-spring stores the energy in a watch, while its rate is determined to a great extent by the hair-spring. Both these parts require extensive care during production, processing and treatment of the metals. The production methods are explained in detail. The shape and the elasticity limit of the main-spring determine the torque during operation. These mechanical data can be related to the physics of metals which uses intuitive models to explain the mechanism of hardening. The different materials used are reviewed. The balance-wheel is discussed from the point of view of the physical phenomena as well as the precision of the rate. The developments which have occurred since the basic researches of Guillaume and P. Chevenard are discussed, especially the dilatation and elasticity anomalies of Fe–Ni-alloys. Author

N65-26719 Technische Hochschule Dramstadt (West Germany).
INVESTIGATION OF THE OPERATION OF ROTORS IN SELF-WINDING WATCHES BY MEANS OF ANALOG [UNTERSUCHUNG DES VERHALTENS VON ROTOREN IN AUTOMATISCHEN UHREN MIT HILFE EINES RECHEN-AUTOMATEN]
H. Bär *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 799–808 In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

The mathematical treatment of the movement of rotors in selfwinding watches leads to a differential equation of the second order for the angle of rotation; this equation cannot be solved in closed form if the acceleration of the arm is not constant but time-dependent. An approximation was computed by means of an analog computer which records graphically the rotation angle as a function of time. Assuming that the acceleration of the arm follows cosine-law, these curves were obtained for different values of the torque of the spring, the dead angle, the frequency of the arm movement; eventually these curves were used to compute the energy accumulated in the spring during the movements of the rotor. Author

N65-26720 Technische Hochschule, Dresden (East Germany).
DIMENSIONING OF SELF-WINDING MECHANISMS [DER EINFLUSS DER DIMENSIONIERUNG VON SELBSTAUFZUGEN AUF DIE AUFZUGLEISTUNG]
Klaus Franze *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 809–822 refs In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

In the self-winding mechanism the mechanical characteristics and the properties of the wearer depend one from the other. The characteristics of the design can be described precisely by physical quantities. Moreover it is possible to measure the essential properties of all self-winding mechanisms with revolving rotors by means of a few numerical values. These values can be measured reproducibly by means of an instrument, the winding meter. The characteristics of the wearer are of a statistical nature and can also be analysed by the winding meter. The analysis of the results shows that the properties of the wearer can also be measured quantitatively and be represented by 2 distributions. The relationship between the properties of the wearer and the mechanical design is fairly linear and reduces to simple dimensioning formulas for the self-winding mechanism. The conclusion is that for all temperaments of potential wearers a basic design can be found, as long as the requirements are not exaggerated. Author

N65-26721 Technische Hochschule Stuttgart (West Germany).
THE MEASUREMENT OF THE TRANSMISSION OF THE TORQUE BY THE GEAR TRAIN IN A WATCH AND THE EFFECT ON THE AMPLITUDE OF THE BALANCE WHEEL [MESSUNG DER DREHMOMENT UBERTRAGUNG DURCH DAS RADERWERK VON ARMBANDUHREN UND DEN EINFLUSS AUF DIE AMPLITUDE DES UNRUHSCHWINGSYSTEMS]
Rolf Erich Müller *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 823–833 In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

The flow of energy from the main spring to the balance wheel via the gear train is visualized. The torque available at the escape wheel is given by the characteristic torque of the main spring on which the fluctuations of the transmission by the gear train are superposed. The author then presents a method by which the torque and its fluctuations can be measured directly at the escape wheel or at any other gear in the train; hereby the fluctuations can be related to their causes. The effective torque at the escape wheel determines the momentum transmitted to the balance wheel and thereby the amplitude of the balance wheel. The variation of the amplitude caused by a given variation of the momentum can be measured; the value of this variation and its dependence as a function of time will be discussed. Author

N65-26722 Besancon Univ. (France). Laboratoire de Mecanique Appliquée.
CONTRIBUTION TO THE KNOWLEDGE OF WATCH GEARS [NOUVEAU PAS DANS LA CONNAISSANCE DES ENGRENAGES D'HOROGERIE]
Claude Oudet *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 835–842 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

By a theoretical and experimental analysis of epicycloidal gears it has been possible to bring closer together the theoretical and experimental diameters which yield the smallest fluctuations of the torque. It is shown too that although the two minima coincide, the theoretical variations of the torque are still smaller than the practically observed variations. The study of the deformation of the gear toothing and of the bending of the pinion leaves furnishes interesting elements for the understanding of these divergences. Author

N65-26723 Junghans Gebrüder, A. G. Schramberg (West Germany).
THE MATHEMATICAL EVALUATION OF TRANSMISSION QUALITIES OF DEFECTIVE GEARINGS IN TIMEPIECES [BERECHUNG DER üBERTRAGUNGSEIGENSCHAFTEN BEI FEHLERHAFTEN UHRENVERZAHNUNGEN]

Friedrich Assmus *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 843-855 In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

For the stability of the rate over a short period of time with timepieces where energy is transmitted from a mechanical power source to the oscillator, the torque, available at the escape wheel, and its fluctuations are of particular importance. Fluctuations of this torque are practically unavoidable, and are due to defects in the shape of the teeth, to inaccuracies of distances between centers and to fluctuations of the mechanical friction. The torques as a function of tooth shape, of deviations of the distances between centers and of the friction coefficient, are obtained through mathematical equations. With these equations, it becomes possible to calculate the possible fluctuations of the production and to predict the overall performance as a function of different gear trains. Author

N65-26724 Societe Suisse de Chronométrie, Neuchâtel (Switzerland).

MATERIALS [MATERIAUX]

J. P. Renaud *In its* Intern. Conf. on Chronometry, Vol. 2 [1964] p 857-880 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The progress achieved during the five or six years concerning the choice of basic materials used in the manufacture of movements and assembly processes is reviewed. Only spirals, spring-boxes and springs are ignored, since they are the subject of a paper by Dr. S. Steinemann. A first part of the paper is devoted to basic materials used in the manufacture of the movement, of the watch-face, and of the glass. A second part touches on the problem of decorative and anticorrosive coatings, rust-proof treatment and passivation films. Finally, a third part establishes the progress achieved in the field of lubrification, oils, greases, solid lubricants, self lubricating materials, and anti-wear coatings. In each case, the industrial application is first discussed, then certain possible developments at a laboratory level which have a potential application to watch manufacture. It concludes with certain indications on the direction of new scientific and technical developments, as well as on problems not yet solved. Author

N65-26726 Societe des Fabriques de Spiraux Réunies, La Chaux-de Fonds (Switzerland).

SOME FACTORS WHICH INFLUENCE THE TEMPERATURE COEFFICIENT [ETUDE DE QUELQUES TACTEURS INFLUENCANT LE COEFFICIENT THERMIQUE]

Willy Zenger, Richard Robert, and Franois Mercier *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 891-904 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

A comparatively large scattering of the temperature coefficient is observed in some watches. The purpose of this study is to determine in which cases this defect is due either to the hairspring or to other factors in the watch. For a constant amplitude, large and sudden variations of rate are observed which influence directly the temperature coefficient of the watch. We present a few diagrams showing these anomalies and, in order to remove them, we analyse their causes. We mention, for instance, the caliber construction, the galvanic treatment of regulator pins and keys, the kind of oil used, the freshness of the oils, escapements, the pivots, the handling and the working of the hairspring, the quality of the assembly of the watch. The various ways and methods used for measuring the temperature coefficient may give the different results. We show various appropriate checking processes. Author

N65-26727 Lausanne Univ. (Switzerland). Laboratoire de Genie Atomique.

EXPERIMENTAL DETERMINATION OF THE THERMAL COEFFICIENT OF WATCH HAIRSPRINGS BY THE METHOD OF THE COMPOUND TORSION PENDULUM [DETERMINATION EXPERIMENTALE DU COEFFICIENT TERMIQUE D'UN SPIRAL DE MONTRE PAR MESURE EN PENDULE DE TORSION COMPOSE]

B. Martinet, B. Secrétan, and B. Vittoz *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 905-915 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The measurements to be described in this paper allowed to solve some of the basic problems concerning the determination of the thermal coefficient of hairsprings by the method of the compound torsion pendulum. One of the most interesting features of this method is the possibility to determine by a measurement of a few minutes the following quantities: a) Period of the pendulum with a precision of 3×10^{-6}; b) Departure from isochronism; and c) Damping of the pendulum as a function of amplitude. The method allows to estimate theoretically some of the factors entering in the determination of the thermal coefficient and to test them by measurements. Others cannot be derived by simple arguments. Only a systematic experimental study will allow to understand all mechanisms influencing the thermal behaviour of the hairspring at different amplitude. Author

N65-26728 Centre Technique de l'Industrie Horlogere, Besancon (France).

HIGH TENSILE STEELS AND THEIR APPLICATION IN WATCHMAKING AND MICROMECHANICS [LES ACIERS A HAUTE RESISTANCE ET LEURS APPLICATIONS EN HORLOGERIE ET EN MICROMECANIQUE]

Gilbert Remy and Michel Massin *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 917-933 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The considerable evolution during the last 10 years of high tensile strength materials has led to the point that at present our industry has a choice of 3 classes of high tensile steels: steels with 5% of Cr, steels with 4.5% of Ni and Maraging steels. These 3 groups of steels are analysed from the point of view of the theoretical capabilities and of their practical applications to the brittle parts of the watch. Author

N65-26729 Centre Technique de l'Industrie Horlogere, Besancon (France). Service des Research.

PLASTICITY AND ISOCHRONISM [PLASTICITE ET ISOCHRONISME]

Pierre Langue *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 935-952 ref In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The actual knowledge on the subject of plasticity is first reviewed. It is then shown how the plasticity of the elastic organ in elastic oscillators can perturb their frequency, i.e. cause a deviation from isochronism. This leads to a precise investigation into the nature of the role of plasticity in elinvar tapes by the analysis of their pulling curves. It is shown that the derivative of these curves can be considered as a sum of Gaussian curves, one main curve and one or two secondary curves which constitute the residue. The relative importance of these curves depends to a great extend on thermal and mechanical treatments of the tape. As a conclusion it is pointed out how the main curve and the residue, depending on their relative importance, can influence the chronometric characteristics. Author

N65-26733 Institut d'Etudes Métallurgiques Appliquées, S. A., Neuchâtel (Switzerland).

CONSIDERATIONS REGARDING THE CUTTING PHENOMENA IN MACHINING PARTS OF WATCHES [CONSIDERATIONS SUR LES PHENOMENES DE COUPE LORS DE L'USINAGE DE PIECES D'HOROGERIE]

Rene Poget and Jürg Seidel *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] 991-999 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The formation of short, segmental chips is observed when brass is machined. The chip thickness depends upon the toughness of thematerial, its cutting ratio and the cutting conditions. A piezoelectrical, dynamometer was used to determine the components of the cutting force and their individual variations. These variations are strongly influenced by the generation of the discontinuous chip. One finds that the roughness in the longitudinal direction mainly depends upon the variations in the cutting force corresponding to a high frequency excitation of the tool. The segmentation of the chips determines a frequency of chip formation which can be measured by a frequency analyzer or by determination of the number of chatter marks per unit time. If this frequency of excitation coincides with the natural frequency of the tool, resonance will result and as a consequence, one encounters high roughness, loss of quality and a decrease in production. The designer therefore should construct a tool whose natural frequency is as far as possible removed from the frequency of chip formation. The tool must be rigidly mounted in the holder and its non supported part must be of minimum length. Author

N65-26735 Technische Hochschule Stuttgart (West Germany) Institut für Uhrentechnik und Zeitmesskunde

QUALITY TESTS OF MECHANICAL WATCHES [QUALITATSPRUFUNG MECHANISCHER UHREN]

G. Glaser *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1021-1049 refs In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

A test of a commercial product when made summarily and on one single sample is of no use. In a short test of the qualities of a mass product by measurements of the rate, it is necessary to test at least 0.5% (or at least 10 samples) which are selected at random from the whole lot; otherwise it is not possible to predict whether or not the product fulfills the minimum quality requirements. Tests which cover several days and which are extended to each single piece, like the chronometer tests, give a fairly accurate picture of the performances of the product and the lot. When a judgment is wanted of the individual organs which determine quality, much more extended examinations are required: study of the finished watch (rate and amplitude); study of the functions of the escapement and its effect on the rate; determination of the properties of the main spring and of the transmission of torque through the gear train; examination of the bearing and lubrication; testing for water resistance and resistance against shocks. Author

N65-26736 Controle Technique Suisse des Montres, Neuchâtel.

THE EVOLUTION OF THE QUALITY OF THE SWISS WATCH [EVOLUTION DE LA QUALITE DE LA MONTRE SUISSE]

R. Payot *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1051-1058 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The relative decrease of the number of watches, which had to be rejected by the Contrôle technique suisse des montres (C.T.M.) during its first year of activity (1962) has been confirmed during 1963. The comparison of the results of 1963 to those of 1962 shows an improvement of 1.0 to 1.5%, depending on the groups (lever, pinlever and Roskopf). The average quality index for each subgroup of lever watches has improved systematically and reached the value of 5.9 against 6.7 in 1962 for men's watches. This remarkable evolution has called for the narrowing of the test limits. The new limits apply since February 1, 1964. Author

N65-26737 Société Suisse de Chronometrie, Neuchâtel.

DEFINITION OF THE MECHANICAL QUALITY OF THE WATCH AND OTHER CLOCKS [SUR LA DEFINITION DE LA QUALITE MECANIQUE DE LA MONTRE ET DES AUTRES HORLOGES]

Edmond Degallier *In its* Intern. Conf. on Chronometry, Vol. 2 [1964] p1059-1064 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

A formula is offered for quantitative evaluation of chronometers having oscillating mechanisms, and of devices for transmitting the energy to maintain and count the oscillations. This formula is the ratio of the potential energy of the oscillator and the kinetic energy of an oscillation, and applies to mechanisms such as springs, scales, and sources of electrical current. The ratio is itself the product of two other energy ratios, where one measures the quality of oscillation and the other the yield of the motivation source. Trans. by J.M.D.

N65-26738 Lip, S. A., Besancon (France).

RELIABILITY IN WATCHMAKING [FIABILITE EN HORLOGERIE]

P. Mervant *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1067-1078 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

High prices and the rigidity of requirements for reliability have caused reliability to be the major problem in modern electronics. Although prices and requirements have no common measure in watchmaking, our industry must nevertheless profit from the latest research efforts made for improving the reliability of electronic devices. There exists, however, between an electronic device and our watch an important difference: while for the former the reliability can be considered as the resultant of the reliabilities of each of its components, this definition is hardly appropriate for watches, which are composed of functional groups that cannot easily be taken apart. General notions concerning the reliability: definition, "outlasting curve", "damaging rate" Weibull function: it is fairly well representative of the distribution of failures in time measuring instruments. Advantage to know the frequency of occurrence of the various failures and their distribution in time and also the mean life-time of a batch. Relationship between life-time and the guarantee-time. Investigation and analysis of the factors causing failures. Help given by the servicing department, examples drawn from experience. Author

N65-26739 Controle Technique Suisse des Montres, Neuchâtel (Switzerland).

THE PERFORMANCES AS FUNCTION OF TIME OF WORN WATCHES WHICH ARE PERIODICALLY SUBJECTED TO STANDARD TESTS [ETUDE DU COMPORTEMENT DANS LE TEMPS DE MONTRES PORTEES, EXAMINEES PERIODIQUEMENT SELON DES NORMES DE CONTROLE]

R. Nicolet, R. Payot, and A. Simon-Vermot *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1079-1090 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The Contrôle technique suisse des montres (C.T.M.) has undertaken a comparative investigation of 150 watches of different brands. The experiment will last one year and will allow useful comparisons between the standard tests of the C.T.M. and the wearing simulator of the Fabriques d'Assortiments Reunies S A. On the other hand it will be interesting to know how the same watch performs when worn by different persons. Electric, lever and pinlever watches in groups of 10 or 20 are worn by persons having different professions and activities. Each month the watches are subjected to the standard tests of C.T.M. and the wearing simulator. The organization, the methods of reduction and a few preliminary results will be described. Author

N65-26740 Besancon Univ. (France). Laboratoire de Mécanique Appliquée

THE RATE OF MECHANICAL WRIST WATCHES IN ACTUAL WEAR [LA MARCHE DES MONTRES-BRACELETS MECANIQUES LORS DU PORTER]

Daniel Jacquet *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1091–1100 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The rate of a mechanical wrist-watch is a function of the conditions during its use. While the watch is worn the balance-hairspring is subjected to a number of disturbing forces, unknown up to now. This paper considers only the "mechanical actions exterior to the watch". After several attempts to reproduce in the laboratory the average conditions of actual wear, the possibilities of success are examined. The basic results of the theoretical analysis of the position errors are applied to the case of actual wear. The essential point is to determine the conditions that have to be satisfied, when the watch is worn, to secure entire satisfaction. This implies the knowledge of the instantaneous acceleration vector at the wearer's wrist. The continuous and precise measuring of this acceleration is realized by means of an original telemetering system. The information is recorded and then treated by a computer. The author describes the present state of his work. Author

N65-26741 Technische Hochschule Stuttgart (West Germany).

RATE AND AMPLITUDE OF BALANCE WHEELS DURING MOVEMENTS OF THE ARM [GANG UND AMPLITUDE VON UNRUHSCHWINGSYSTEMEN BEI ARMBEWEGUNGEN]

R. Zscherpel *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1101–1112 refs In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

The instantaneous measurement of the rate and amplitude are measured of a watch being worn. In order not to inconvenience the wearer of the watch and his natural movements, the oscillations of the balance wheel are measured photoelectrically and transmitted by radioelectric means. An electronic circuit sorts the transmitted pulses according to rate and amplitude. Transistorized logic circuits had to be developed in order to have the measurements of rate and amplitude available immediately after each passage of the oscillator. The recorded curves show clearly the importance of the movements, especially of short rotating shocks. The transient phenomena of the amplitude following the shock are also clearly visible on the curves. Even important instantaneous variations of rate are shown to average out approximately. Author

N65-26742 Société Suisse de Chronometrie, Neuchâtel.

ON THE EFFECT OF ACCELERATION ON THE RATE OF WATCHES [INFLUENCE DE L'ACCELERATION SUR LA MARCHE DES MONTRES]

J. D. Pellaton and C. Attinger *In its* Intern. Conf. on Chronometry, Vol. 2 [1964] p1113–1123 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

In vehicles, speeding through curves of small radius, watches may be subjected during a short time to accelerations of several g's. One has attempted to reproduce these conditions by fixing the watch on a turntable of variable rotating speed. Rate and amplitude were measured by converting the noises of the watch into a radio signal and receiving it by means of a portable receiver. The influence on the rate is clearly observable for accelerations as low as a few g's. Stopping of the watch occurs between 10 and 30 g's, depending on the caliber and the position of the watch on the turntable. Author

N65-26743 Kienzle Uhrenfabriken, A. G., Schwenningen (West Germany).

THEORETICAL AND EXPERIMENTAL STUDIES OF BALANCE WHEEL PIVOTS DURING SHOCKS [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN ZUM VERHALTER DER UNRUHZAPFEN BEI STOSSEN AUF DIE UHR]

Albrecht Haag *In* Soc. Suisse de Chronomètrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1125–1143 refs In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

Assuming rigid bearings and a rigid rim, movements of the balance wheel, are possible during shocks because of the elasticity of the pivots. When the action of the force is over, the mass of the balance wheel goes back to its original position through damped oscillations, provided the pivots have not been deformed plastically. In order to calculate the behaviour of pivots in the elastic range during the application of large accelerations it is appropriate to use the mechanical model of a point of mass held in place elastically and linearly movable. The displacement of the mass can be found theoretically when shock with accelerations in any direction and of any time dependence are applied. The elastic and non elastic behaviour of the pivots under bending forces can be measured by the application of static forces. If the time dependence of the acceleration during shocks can also be measured or estimated, the deformations of the pivots which will occur when shocks are applied can be anticipated through the simultaneous knowledge of the theoretical relationships and the experimentally determined quantities. The actual behaviour of the pivots when shocks of known characteristics were applied, gave a very satisfactory agreement between calculation and measurement. Author

N65-26744 Observatoire Cantonal, Neuchâtel (Switzerland).

THE TESTING OF CHRONOMETERS UNDER CONSTANT PRESSURE AT NEUCHATEL OBSERVATORY [LE CONTROLE DES CHRONOMETRES A PRESSION CONSTANTE A L'OBSERVATOIRE DE NEUCHATEL]

F. Egger *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1145–1151 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

New rooms have been constructed which are held under constant pressure; a few results are presented. Author

N65-26745 Société Suisse de Chronometrie, Neuchâtel.

TESTING OF THE SURFACE POLISH OF WATCH STONES [CONTROLE DU POLISSAGE DE LA SURFACE DES PIERRES D'HORLOGERIE]

C. Attinger, J. Beguin, and H. E. Hintermann *In its* Intern. Conf. on Chronometry, Vol. 2 [1964] p 1153–1163 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The quality of the surface polish of different watch stones is examined by means of interference and electron microscopy, in particular the surfaces of pallet-stones, cap jewels and jewel holes. Differences of the polish on various functional surfaces can be distinguished, the polish of jewel holes being distinctly inferior to that of plane surfaces. Furthermore, the zone of wear of a cap jewel, caused by the rotation of a balance-staff is compared to the adjacent untouched area of the stone. The axle's movement forms a small indentation, the depth of which is measured by means of the interference microscope. It is observed that—even with the electron microscope at a magnification of 10000X—the surface structure of the zone of wear cannot be resolved, i.e. neither polishing scratches nor inherent characteristics can be observed. This would appear to represent an almost ideal surface polish. Author

N65-26746 Societe Suisse de Chronometrie, Neuchâtel.
MEASUREMENT OF THE ACTIVITY OF WATCHES [MESURE DE L'ACTIVITE DES MONTRES]
Hans R. Enz *In its* Intern. Conf. on Chronometry, Vol. 2 [1964] p 1165–1174 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The radioactive luminescent compounds used in watches may have roughly the following activities: 0.1 μc Ra-226, 100 μc Pm-147 or 1 mc T for one watch. The way of measuring these activities at the L.S.R.H. and at the C.T.M. is exposed. The C.T.M. is just beginning to check the radioactivity of swiss watches. It is supervised by the Federal Office of Health. The time for one measurement and the accuracy of the result is given, together with a short description of the kind of measuring apparatus. Author

N65-26747 Société Suisse de Chronometrie, Neuchâtel.
DETERMINATION OF SOME ADDITION AGENTS TO GALVANIC BATHS [DETERMINATION DE CERTAINS ADDITIFS DANS LES BAINS GALVANIQUES]
Philippe Javet and H. E. Hintermann *In its* Intern. Conf. on Chronometry, Vol. 2 [1964] p 1175–1184 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

All industrially used galvanic baths contain addition agents to improve the quality of the metallic deposit (hardness, brightness) or its homogeneous distribution over the metallic base (throwing power). These addition agents whose reaction mechanism is as yet not well understood, are usually used in extremely small concentrations in the plating solutions. Sensitive methods are required to determine them quantitatively. Chromatography, as one of these methods, allows a qualitative estimation of the bath composition; UV-spectrophotometry, on the other hand, allows a quantitative determination of certain additives. A few examples of the determination of addition agents in copper and nickel plating baths as well as a practical application of these methods are given. Author

N65-26748 Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
TESTING THE ABSENCE OF LEAKS IN WATCH-CASES BY MEANS OF AIR STREAMS [VERGLEICH DER VERFAHREN ZUR PRUFUNG DER WASSERDICHTHEIT VON UHRGEHAUSEN MITTELS TESTLECKS]
S. German *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1185–1201 In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

Comparative studies are carried out by the different methods for measuring the tightness of watch-cases by means of the flow of liquids and gases. In order to better appreciate the merits of the different methods, the behaviour of the leaks is examined. Author

N65-26749 Société Suisse de Chronometrie, Neuchâtel.
CALCULATIONS AND MEASUREMENTS ON MULTIPLE MAGNETIC SCREENS [CALCULS ET EXPERIENCES SUR DES ECRANS MAGNETIQUES MULTIPLES]
Norberto Perucchi *In its* Intern. Conf. on Chronometry, Vol. 2 [1964] p 1203–1210 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The subject of this paper is the study of magnetic screens with multiple layers for applications in the watch industry. After presentation of a calculation method and test of the solutions, results of a few experiments performed with different materials are given. These results show the relative importance of the permeability, the layer thickness and the number of layers for the effective value of the screening factor for such magnetic fields, which influence notably the rate of a watch. Author

N65-26750 Technische Hochschule, Stuttgart (West Germany).
A PROCEDURE FOR ESTIMATING THE BEHAVIOUR OF A WATCH ACTUALLY WORN FROM INSTANTANEOUS MEASUREMENTS OF ITS RATE [EIN VERFAHREN ZUR BESTIMMUNG DER GANGGENAUIGKEIT VON ARMBANDUHREN AUS KURZFRISTIGEN GANGMESSUNGEN]
Konrad Dittmar *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1211–1217 In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

A procedure is presented by which it is possible to estimate the performance of a watch in use by means of the measurement of its rate in different positions, winding conditions and temperatures and provided the conditions of its actual use are known. The results will be corroborated by experimental evidence. Author

N65-26751 Institut Straumann, A. G., Waldenburg (East Germany).
NEW DEVICE FOR THE MEASUREMENT OF THE RATE OF WATCHES [NEUERE UNTERSUCHUNG DER GANGMESSUNG]
F. Straumann, F. Kestenholz, and W. Brombacher *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1219–1232 refs In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

The new device shows the following characteristics: measurement of the rate by binary counters, the sign of the rate deviation being also available; analog output with the choice of several time-constants; digital output for punched tape; electronic sorting circuit by which any two limiting values can be set. The instrument is built essentially around commercially available logic elements. A few applications for the instrument are discussed. Author

N65-26753 Deutsches Patentamt, Munich (West Germany).
THE WATCHMAKING INDUSTRY AND THE FUTURE DEVELOPMENT OF THE PATENT SITUATION [DIE UHRENINDUSTRIE UND DIE ZUKUNFT DES EUROPAISCHEN PATENTWESENS]
J. Baltzer *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1243–1259 In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

The patents assume for the watchmaking industry a paramount role for a number of technical and commercial reasons. The author reviews in detail the legal patent siutations in the different countries discussing the advantages and drawbacks of the different systems currently applied. All European countries, in particular those of the common market, have plans for or have already passed new patent laws. The author gives a detailed account of the new situation which will arise when these laws will be promulgated. Author

N65-26754 Staatliche Mathematisch-Physikalischer Salon, Dresden (East Germany).
THE COLLECTION OF CLOCKS AND WATCHES OF THE STAATLICHER MATHEMATISCH-PHYSIKALISCHER SALON IN DRESDEN [DIE UHRENSAMMLUNG DES STAATLICHEN MATHEMATISCH-PHYSIKALISCHEN SALONS IN DRESDEN]
M. Grötsch *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1261–1262 In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

A few of the most precious masterpieces of this collection are shown on color slides. The collection which was founded in 1560 includes many outstanding works of German watchmakers of the 16th and 17th century. First are shown sundials of all kinds, beginning before the 16th century, then the well-known noon canons of the 18th century. Then many remarkable small mechanical portable clocks are shown. Finally many examples of hour glasses, automatic clocks, astronomical clocks and many other items are shown which are internationally note-worthy because of their artistic or curiosity value.
Author

N65-26755 Le Coultre et Cie, Le Sentier (Switzerland).
MANUFACTURE OF THE WATCH [FABRICATION DE LA MONTRE]
Jean Lebet *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1263–1275 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

During the last years the requirements and specifications imposed on a watch, price-wise and quality-wise, have considerably increased. On the other hand the progress of applied science and the problems associated with the shortage of skilled labour play an increasing role. These facts lead to the necessity to reconsider all the methods used in watch making. Some partial solutions have been already proposed. The problem discussed here is the problem of manufacture. At the same time it is interesting to compare the problems of today to those which have been solved at the beginning of the 19th century by foreseeing and energetic men. Indeed, certain principles introduced at that epoch are still basic for the present manufacturing methods; although they have been improved in many ways, our present watchmaking machines are the direct descendants of those of the 19th century. The outstanding qualities of the old pioneers still inspire us profitably.
Author

N65-26756 Westclox Div., General Time Corp., La Salle, Ill.
TECHNICAL AND ECONOMICAL LIMITS OF AUTOMATION IN THE CLOCK INDUSTRY
A. L. Spetzler *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1277–1286 (See N65-26708 16-14)

An approach to the problem of determining the feasibility of automating particular industrial processes is discussed. The automation of assembly lines is reviewed to illustrate a method of deciding whether automation should be attempted, what parts or assemblies are best suited for automation, and which procedures can be used effectively. Certain steps are necessary for successful automation: market research to determine if the automated product can be sold within the next five to ten years, product analysis to find the product design which best lends itself to automation, production research into the types of devices which can be useo for automation and what their cost would be, and estimation of the gain from automation in light of the above analyses.
J.M.D.

N65-26757 Bureau des Normes de l'Industrie Horlogere Suisse, Neuchâtel.
STANDARDIZED SCREW THREADS [LE FILETAGE NORMALISE]
Henri Cart and René Diel *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1287–1295 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The standardization of threads has been worked out within the frame of the technical committee "Threads of the I.S.O.". The results of the first work session have been published in the "Recommandation ISO R 68" in 1958. In this recommandation the basis profile is set as well as the dimensions of threads form 0.25 to 5 mm, or from 0.01 to 0.197 inches. This new profile is very truncated (twice as much as usual) which allows stronger cutting tools and imparts more resistance to the screw since its inside diameter is larger. In 1961 a first proposal concerning the tolerances of the triangular ISO profile was presented; it propses 3 threaded lengths, 2 qualities and 2 types of adjustment for all threads up to 6 mm in diameter, in other words 12 distinct cases for the threads used in watchmaking; this would be highly impractical. New proposals have been made concerning the small threads up to a diameter of 1.4 mm. These proposals have been worked out by a study group composed of delegates from Germany, United Kingdom, France and Switzerland, and stem from the study of a document prepared by the Swiss watchmaking industry. The standards NIHS conform to the basic principles proposed internationally.
Author

N65-26758 Greiner Electronic, S. A., Besancon (France).
PRESENTATION OF A SET OF MEASURING INSTRUMENTATION FOR WATCHMAKING LABORATORIES [PRESENTATION D'UN ENSEMBLE D'APPAREILS DE MESURES DESTINES AUX LABORATOIRES HORLOGERS]
Philippe Lecot *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1297–1311 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

Like in other industries the technical progress in the watch industry stems more and more from quantitative measurements, rather than from vague feelings. Concepts which have long been used in other industries are being applied also to the watchmaking industry and laboratories are becoming essential tools. Laboratories of individual firms are no longer the hobby of the management but important centers from which product improvements originate and information centers for the development of the firm. Which is the information a laboratory of a firm must gather and how is such a laboratory to be organized? Author

N65-26759 Fabriques d'Assortiments Réunies, Le Locle (Switzerland).
PRESENTATION OF EQUIPMENT DESIGNED FOR WATCH MOVEMENT ANALYSIS [PRESENTATION D'UN APPAREILLAGE COMPLET POUR L'ANALYSE DE MOUVEMENTS D'HORLOGERIE]
A. Unternährer and A. Simon-Vermot *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1315–1322 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The described equipment uses a classic measurement method: The counting of a standard frequency during a time interval triggered by the event itself. This technique has a very flexible application for the study of watch movement characteristics, since it enables to record simultaneously the amplitude and the period of a free or sustained balance-wheel. The study of the operation of the main parts of a watch, escapement and oscillator becomes easier. The novelty of the presented equipment is, in addition to a fully transistorized design, to have the possibility to select instantaneously the functions necessary for the study of one or the other characteristic of a given watch. In addition to the digital recording, it is possible

to obtain analog curves. A few typical applications are presented after the description of the overall electronic characteristics. Author

N65-26760 Ebauches, S. A., Neuchâtel (Switzerland).
ELECTRONIC INSTRUMENTS FOR THE MANUFACTURE OF WATCHES [APPAREILS ELECTRONIQUES POUR LA FABRICATION HORLOGERE]
J. Engdahl and H. de Montmollin *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1323–1336 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The manufacture of watches and particularly of the ébauches tends increasingly to be automated and electronic devices become more and more important. The author explains a few of the electronic controls of machine tools which have been realized by means of logic units. Several new instruments will be presented, in particular: a universal programmer for experiments to programmed automatic controls; a proximity detector of high precision; a photoelectric transducer; contact detectors of high resistance for checking for example the correct positioning of work pieces. Author

N65-26761 Greiner Electronic, S. A., Langenthal (Switzerland). Laboratoire de Technique Horlogère.
MECHANICAL PINNING UP TO THE COLLET [UNE NOUVELLE METHODE DE VIROLAGE MECANIQUE]
Jean-Jacques Augsburger *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1337–1346 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The conventional pinning up to the collet is a very expensive operation, which may only be executed by highly qualified personnel and is not adapted for a mechanization. According to the conditions under which it is made, it may lead to a serious perturbation of the characteristics of the modern hair-springs. A new method of the mechanical pinning up to the collet has been studied. The fundamental principle of this method is a collet of a new conception, which ensures the automatic centering and the flat of the balance-spring. The spring itself is not deformed and keeps entirely its qualities. Its geometrical dimensions being perfectly determined, it becomes possible to test it by objective means and to arrive at small dispersions of the mass production. Author

N65-26762 Institut Straumann, A. G., Waldenburg (East Germany).
BALL BEARING FOR WATCHES AND INSTRUMENTS [KUGELLAGER FUER UHREN UND INSTRUMENTE]
O. Tschudin *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1347–1356 refs In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

The kinematics in miniature ball bearings with 3 balls and 3-point support is treated as a pointed seat for all possible spatial position of the staff. Relatively large balls with a two-point guidance in the sleeve are advantageous for the suppression of a drilling motion between ball and staff cone and also to assure minimum fluctuations in friction for the seating of pivots in the case of vibrational systems. The behavior of the bearing during oscillation of the staff is also treated. The contribution to friction due to mutual ball contact is appreciably smaller than in the case of a rotating staff. A testing instrument for measuring the free angle of rotation is described. Results obtained with the miniature ball bearings in watches are presented. The balances tend to knocking, require weaker springs, reach their final amplitude very rapidly, and show a remarkably small variation of the amplitude. The shaping of the sleeve is described for the case where age-hardenable materials with preceding cold forming are used, and also for the springloaded, concentric arrangement in the bearing bushings with standardized dimensions. Author

N65-26763 Suwa Seikosha Co., Ltd. (Japan).
ON THE EFFECT OF THE HAIRSPRING ECCENTRICITY
Kenji Abe *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1357–1366 refs (See N65-26708 16-14)

The deviations from isochronism have been treated by the method due to J. Haag, S. Goudsmit, M. Wang and H. Hasnuma when the geometrical center of hairspring at the equilibrium position of the system of hairspring and balance wheel shifted from the center of rotation of balance wheel. Consequently, the deviations of period have been obtained as follows:

$$\delta = \frac{4\pi^2}{L}\cdot\frac{\phi^2\phi_0^2}{\phi^2+\phi_0^2}\cos(\phi-\phi_0)[AJ_1(A)-J_0(A)]$$
$$+\frac{4h}{L}\left[\frac{\phi^2}{\phi^2+\phi_0^2}\sin(\phi_0-\beta)-\frac{\phi_0^2}{\phi^2+\phi_0^2}\sin(\phi_0-\beta)\right]J_0(A)$$
$$+\frac{4h^2}{\pi^2(\phi^2+\phi_0^2)}\frac{J_1(A)}{A}$$

Here, A, the amplitude of balance wheel in radian; $J_0(A)$ and $J_1(A)$, Bessel functions of zero and 1st order, respectively; $2\pi a$, the pitch of hairspring; $\phi-\phi_0$, the total angle of hairspring from the pinning point to the curve-pins; h, the amount of the eccentricity; β, the direction of the eccentricity. The above formula is nearly in accord with the experimental results obtained by Y. Oshima. Author

N65-26793 Aerojet-General Corp., Sacramento, Calif.
AN OPTICAL SCANNING SYSTEM FOR MULTIAXIAL STRAIN MEASUREMENTS
C. C. Surland and G. R. Givan *In* APL Bull. of the 3d Meeting Interagency Chem. Rocket Propulsion Group Apr. 1965 p 85–99 ref (See N65-26788 16-27)

An electro-optic device for making multiaxial strain measurements is presented. The basic design of the instrument is described, and optical scanner data are reported and compared with data from various other strain measuring techniques. The device requires only visual access to a test surface in order to make the strain measurement; no mechanical contact with the specimen is necessary. Test data are given which demonstrate the case with which the optical scanner can measure multiaxial strains. This prototype instrument appears to be applicable for a variety of strain and deformation measurements of propellant specimens and grain structures. J.M.D.

N65-26880* National Bureau of Standards, Washington, D. C.
STANDARDS, SOURCES, AND DETECTORS IN RADIATION MEASUREMENTS
Ralph Stair and William E. Schneider *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 217–231 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

The NBA standards of total and of spectral irradiance and of spectral radiance are based upon the Stefan-Boltzmann and Planck laws of radiation and, as set up in terms of lamp sources, are in close agreement with each other and with the NBS standard of luminous intensity. Their use in the calibration of various sources requires great skill in the operation of spectroradiometric equipment employing detectors having sensitivities that vary over the detector surface or that vary with wavelength.

Examples are given illustrating the wide ranges in sensitivity which may exist over the surface of certain detectors and also the large variation of sensitivity with wavelength of supposedly neutral thermal detectors. General suggestions are made regarding methods for obtaining accurate results in the different types of measurement. Author

N65-26911* Boeing Co., Seattle, Wash.
THERMAL SENSOR DESIGN FOR GLIDE REENTRY VEHICLES
F. S. Brunschwig, G. E. Koch, and J. K. Wilhelm *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 567-579 refs (See N65-26855-16-33) GPO: HC $3.75 CFSTI: MF $2.75 CSCL 20M

Thermal sensors containing thermocouples for the measurement of surface temperature and the impinging heat-flux on glide reentry vehicles have been developed. Data for these sensors obtained by heating in plasma, furnace, and rocket exhaust are presented, together with a discussion of the thermal and electrical phenomena involved. Experience with the design of aerodynamic heat-flux sensors has led to the interpretation of the measured temperatures by means of the heat transfer differential equation to obtain the incident aerodynamic heat-flux with better accuracy than direct heat-flux instrumentation. A digital computer program establishes surface temperature and compute aerodynamic heat-flux from temperature data. Author

N65-26915 Joint Publications Research Service, Washington, D. C.
SEMI-CONDUCTOR SUPERSONIC WAVE THICKNESS MEASUREMENT INSTRUMENT
In its Transl. on Communist China's Sci. and Technol. No. 190, 23 Jun. 1965 p 6-7 Transl. into ENGLISH from Hsin-min Wanpao (Shanghai), Apr. 1965 p 1 (See N65-26914 16-34) CFSTI: $1.00

The manufacture of a semiconductor supersonic wave thickness measurement instrument for the determination of erosion of ship hulls is discussed. It is indicated that the instrument is compact, precise, and has a high degree of sensitivity. Further, it is noted that technical standards have reached the advanced level of similar foreign manufactured instruments. E.E.B

N65-26925# Lincoln Lab., Mass. Inst. of Tech., Lexington. Electronic Systems Div.
PROGRAMMABLE FILM READER Technical Note 1965-1
A. W. Armenti, D. F. Clapp, A. I. Schulman, and R. A. Wiesen 10 Mar. 1965 194 p refs
(Contract AF 19(628)-500)
(ESD-TDR-65-57; AD-615106)

The Programmable Film Reader, consisting of digital computer, magnetic tape units, CRT, and film transport with optical and electronic circuits, is a device for reducing radar A-scope film data to digital form. This is done by scanning selected portions of the film with a spot of light under program control. The relative amount of light passing through the film is measured by the device and reported back to the computer for processing. A set of computer programs, called the Film Reading Program System, has been written for the PDP-1 computer and Programmable Film Reader. These programs will read films in three formats: A-scope traces, A-scope traces with fiducial marks and Project Radar A-scope traces. The amplitudes of the traces are sampled up to about 500 times and the digitized results written onto magnetic tape in IBM format. This report presents a description of the computer programs together with flow charts and listings. The reader is presumed familiar with the PDP-1 computer and the MACRO assembly language. The latest modification to the system adapts it for use with the MIDAS assembly program and with a new high-speed magnetic tape system on the PDP-1 computer. Author

N65-26963# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
γ-RAY DOSIMETRY WITH p–i–n JUNCTION COUNTERS
A. R. Jones Feb. 1965 17 p refs
(AECL-2252) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

A contract was awarded for the development of a manufacturing process for low cost p–i–n junction counters. The specifications related to a 5 mm^2 and a 100 mm^2 junction with an intrinsic layer thickness of 1 mm. The report describes the performance of 20 samples supplied under the contract as γ-ray dosimeters and the stability of this performance over a period of 19 months. In addition, suitable techniques and circuits to permit the application of these detectors to γ-ray dosimetry are described. Author

N65-27021# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
A SCRAM BYPASS SYSTEM USING ZENER DIODES AS LOGIC ELEMENTS
William J. Woodward Jun. 1965 9 p ref
(Contract AT(07-2)-1)
(DP-926) CFSTI: $1.00

A control chassis containing a group of reactor scram relays is described. A bypass switch is provided for each of the relays, but a zener diode logic circuit requires a certain minimum number of relays not to be bypassed before the reactor can be started up. The reactor is scrammed when any one of the unbypassed relays calls for a scram, or when less than the minimum number of scram relays is in service. Author

N65-27046# Weapons Research Establishment (Australia).
SOME ERROR SOURCES IN HIGH-FREQUENCY HOT-STYLUS RECORDERS
J. Keen Mar. 1965 28 p refs
(WRE-TN-ISD-54)

Records produced by hot-stylus recorders suffer from two types of error peculiar to these instruments. These errors are temperature-dependent errors and geometry-dependent non-linearities. This note discusses methods of minimising the temperature-dependent errors which take the form of variable damping; non-linearity curves are derived for the geometrical factors. Author

N65-27048# California Univ., Berkeley. Lawrence Radiation Lab.
ULTRACENTRIFUGE PHOTOELECTRIC SCANNER, MULTIPLE CELL
Kenneth W. Lamers 1 Apr. 1965 30 p refs
(Contract W-7405-ENG-48)
(UCRL-11623)

This report describes the modifications for conversion of an electromechanical scanner to multiple-cell operation and doubles as an instruction manual. The scanner is used for displaying optical density changes that take place when a light-absorbing material such as virus, protein, or nucleic acid is sedimenting in the centrifugal field of an ultra-centrifuge–that is, a high-speed centrifuge employing an optical system. These materials absorb some of the light transmitted by the optical system, thereby projecting a pulsating image that varies in intensity with distance from the center of rotation. This image

is scanned by a photomultiplier and compared with the pulsating image of a reference cell in order to compensate for nonuniform illumination and other optical imperfections. Circuitry separates the reference and sample pulses, subtracts their logarithmic equivalents, and displays the subtraction on a chart recorder. The chart moves in synchronism with the scanner, and optical density (concentration) is therefore displayed as a function of radius. The system includes additional features such as: (a) an internal calibration that permits measurements of absolute density; (b) a monochromator to facilitate spectral analysis, a powerful tool for disclosing the radial distribution of components responsive to different wavelengths; and (c) derivative of the function, which is displayed in time coincidence. The system described is an improved version of an earlier model in that it is designed (a) for two double-sector cells separated 180 deg, with sector separation 2.5 deg, at each cell, or (b) for two single-sector cells, also separated 180 deg. Single-sector cells are 4-deg; this permits longer slits and increases illumination proportionately. Other modifications improve basic performance over that of the earlier version. Author

N65-27076# Harry Diamond Labs., Washington, D. C.
NOTES ON THE USE OF SEMICONDUCTOR STRAIN GAGES
Harry J. Davis and Leon Horn 30 Apr. 1965 14 p refs
(HDL-TR-1285; AD-615802)

The properties, advantages, and limitations of semiconducting strain gages as measurement tools are reviewed from the user's point of view. Conventional and semiconductor gages are compared. Compensation techniques for nonlinearity and for temperature effects are described. Author

N65-27130 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF SCATTERED ULTRAVIOLET RADIATION IN THE UPPER ATMOSPHERE OF THE EARTH
S. I. Babinchenko, I. P. Karpinskiy, S. A. Kaplan, V. V. Katyushina, L. N. Krylov et al *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 91–134 refs (See N65-27125 16-13)

An apparatus for registration of scattered ultraviolet radiation in the earth's upper atmosphere is described. The apparatus consists of two NO-filled Geiger photon counters with lithium fluoride windows, sensitive in the band from 1050 to 1340 A; a supplementary calcium fluoride (CaF_2) filter was placed in front of one of the counters. The pulses taken from the counter anode were registered by a two-channel logarithmic ratemeter in the counting-rate interval from 2 to 2×10^3 pulses-sec^{-1}. The system is of modular design and consists of a preamplifier, a trigger, a pulse normalizer, an accumulator, a direct-current amplifier, a power supply stabilizer and a high-voltage voltage converter for powering the photon counters. Author

N65-27135 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTIMUM ANALYZER DESIGNS FOR A RADIO-FREQUENCY MASS SPECTROMETER WITH TWO AND THREE DRIFT SPACES
M. Ya. Shcherbakova *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 213–220 refs (See N65-27125 16-13)

The author has used numerical methods (with the aid of an electronic computer) to investigate relationships obtained earlier for conversion of ion energy in the analyzer of a radio-frequency mass spectrometer with two and three drift spaces, and found the optimum relationships for the drift lengths. Analyzer-design variants recommended for practical use are given a table. Author

N65-27155# Westinghouse Electric Corp., Pittsburgh, Pa. Research Lab.
RESEARCH AND DEVELOPMENT OF A CAMERA TUBE FOR NIGHT VIEWING Final Report, 1 Jul. 1963–31 Oct. 1964
G. A. Klotzbaugh 3 Dec. 1964 44 p ref
(Contract DA-36-039-AMC-03205(E))
(RR-64-912-255-R7; AD-615748)

This report describes the complete results on a camera tube designed for low light level applications. This tube has been called the Image-Intensifier Vidicon; in reality it is an SEC vidicon with two TSE dynodes for pre-beam multiplication. For reasons explained in this report, the SEC target replaced the EBIC target that had been used in the previous contract. Ten tubes were completed under the present contract, of which 7 were successfully tested. Measured pre-beam gains for these tubes have been in excess of 4000. As a camera tube, these tubes demonstrated the advantages of the SEC vidicon: nonblooming vidicon-type scan; high target storage capacitance; good picture quality at low light levels; and rapid signal readout in one frame. Author

N65-27172# Navy Electronics Lab., San Diego, Calif. Engineering Test Div.
A HIGH-SPEED INFRARED MAPPING SYSTEM FOR RELIABILITY ASSESSMENT OF MINIATURE ELECTRONIC CIRCUITS
H. F. Dean and R. M. Fraser 15 Mar. 1965 21 p
(NEL-1272; AD-615018)

A system consisting of a cryogenically cooled infrared detector, a scanning mechanism, electronic circuitry, and a modified facsimile machine was developed. The infrared energy maps produced proved the feasibility of high speed thermal mapping of miniature electronic circuits. It is shown that useful maps can be produced at environmental temperatures of 60° to 70° C. This range is below the temperatures normally considered destructive for most electronic materials. A mapping speed of one-in. sq of surface area per 30-minute period is possible R.R.D.

N65-27227 Joint Publications Research Service, Washington, D. C.
ON THE AMPLIFICATION OF PLASMA WAVES ASSOCIATED WITH TRANSITORY RADIATION AT A SHARP BOUNDARY BETWEEN TWO MEDIA BY MEANS OF A FLUX OF CHARGED PARTICLES
S. M. Faynshteyn *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 16–26 refs (See N65-27225 16-34)
CFSTI: $6.00

Presented is a theoretical analysis of inherent problems associated with the amplification and attenuation of plasma waves by a quasi-neutral flux of charged particles at a sharp boundary between two plasmas. Reported are results of an investigation of a monovelocity flux of particles using the quasi-hydrodynamic method, and an investigation of a flux with thermal scattering with respect to velocities using the Einstein coefficient method. Considered in the analysis are instabilities connected with Cherenkov and magnetobremsstrahlung radiation. S.C.W.

N65-27306# Bendix Corp., Southfield, Mich. Research Labs Div.
TRI-APERTURE DISSECTOR READOUT DEVICE Final Report
15 Apr. 1965 100 p refs
(Contract N123(62738)35256A)
(Rept.-2953; AD-615002)

A Tri-Aperture Image Dissector Tube utilizing electrostatic focusing and deflection and Channeltron multiplier readout elements was studied and shown to be feasible. Trade-offs of various design parameters were established, and a new deflection yoke design, using plates having continuous resistive surfaces, was studied and shown to offer substantially greater sensitivity than other electrostatic deflection yokes. The performance of the Channeltron multiplier readout assembly was investigated and found to be satisfactory. Author

N65-27327# Harry Diamond Labs., Washington, D. C.
A BACKSCATTER NEPHELOMETER Final Report
Donald J. Mary 24 Feb. 1965 21 p refs
(TM-65-11; AD-614829)

A device to measure the backscatter of optical radiation by fog is described. The integrated scattering coefficient $\mu(\phi)$ can be measured over the range $178 < \phi < 179.3$ deg in the spectral region of 0.64 to 1.07 microns. Equations relating $\mu(\phi)$ and the system parameters are presented. Author

N65-27340# Du Mont (Allen B.) Labs., Inc., Clifton, N. J. Tube Div.
DEVELOPMENT AND FABRICATION OF MINIATURIZED ELECTRONIC IMAGE MAGNIFIER TUBE Technical Progress Report, 1–31 Jan. 1965
Joseph Burns 8 Feb. 1965 4 p
(Contract N123(62738)50517A(X))
(TPR-4)

A first prototype design magnifier has been fabricated and a tube, employing coaxial and beaded stand-off construction, has been assembled. A glass rodding fixture is being designed to effect a more rugged construction, increase assembly precision, and substantially reduce fabrication labor of the final design prototype. Electron trajectory data obtained from a computer program is being superimposed upon field plots for study, and modifications of these data will be applied to the tubes subsequently fabricated. M.W.R.

N65-27369*# Aracon Geophysics Co., Concord, Mass.
APPROACES TO ON-BOARD GRIDDING OF APT PICTURES Summary Report, Phase I
Robert P. Bartlett, ed. Mar. 1965 68 p ref *Its* Rept. 9G9-11
(Contract NAS5-9012)
(NASA-CR-63588) CFSTI: HC $3.00/MF $0.50 CSCL 14E

Cloud-cover pictures taken with the Automatic Picture Transmission system designed for the Nimbus satellite and experimentally tested on a TIROS satellite, do not pass through a central processing station. These pictures are received directly by the ultimate user from the satellite. Any geographic referencing of the data in the pictures (latitude-longitude grid) must be accomplished by the receiver (user) of the data or must be added to the video picture in the satellite. This report contains the results of a study of the various methods by which the latitude-longitude grid can be added to the video picture on board the satellite. Both analog and digital approaches to onboard gridding were considered. Several digital approaches were found feasible. These approaches call for computer computation of the picture grids on the ground, transmission of the grid line data to the satellite for storage, and logic circuitry to withdraw the data from memory and electronically mix grid line marks into the video during the picture scan. The approaches judged feasible are: (1) straight-line method where the curved grid lines are approximated with straight line segments whose slope, length and initial coordinates are transmitted to the satellite, (2) coordinate method where the individual image plane coordinates of each mark are transmitted, (3) slope-coordinate method where starting coordinates and a slope range are specified to reduce the information necessary to obtain the image plane coordinates of each mark. On the basis of preliminary designs, the flight system weight and power requirement is approximately 7–8 pounds and less than 2 watts respectively. Author

N65-27375*# Cambridge Systems, Inc., Newton, Mass.
DESIGN AND TESTING OF AN AEROSPACE DEW POINT HYGROMETER Final Report
2 Nov. 1964 23 p
(Contract NAS9-2917)
(NASA-CR-63620) CFSTI: HC $1.00/MF $0.50 CSCL 04B

This document describes the design and testing of an Aerospace Dew Point Hygrometer System, developed for use in spaceflight instrumentation systems. The hygrometer described is of the thermoelectrically cooled and optically detected dew condensing type. The hygrometer system consists of a miniature dew point sensing assembly, and a separate control amplifier, power supply, and signal conditioning package. The components are designed to meet rigorous space flight qualifications. Tests conducted to demonstrate that the hygrometer system meets such qualifications are described. Author

N65-27383*# Western Ontario Univ., London.
INTENSITY MEASUREMENTS OF THE LYMAN–BIRGE–HOPFIELD SYSTEM OF NITROGEN
Donald James Mc Ewen (Ph.D. Thesis) 1965 140 p refs
(Grants NsG-349; AF-AFOSR-62-236; Contract AF 19(628)-2820)
(NASA-CR-63641) CFSTI: HC $4.00/MF $1.00 CSCL 20F

The current interest in the vacuum ultraviolet radiation emitted by the sun, the aurora and other sources has shown the need for development of techniques for measuring radiation intensities and for laboratory measurements of band intensities of molecular band systems in this spectral region. The present work is directed towards this end. Studies of the Lyman–Birge–Hopfield system of N_2 and the Fourth Positive system of CO, excited in laboratory discharges, are made and a number of new bands reported. Modifications to the vacuum spectrograph to permit photoelectric recording are described and a number of methods of calibrating the instrument are investigated. Using a combination of techniques the spectral sensitivity of the instrument is determined over the region 1000 to 3000 A. This instrument is used to measure the relative intensities of bands of the Lyman–Birge–Hopfield system. The results show that the electronic transition moment is constant over the band system. The band strengths are thus directly proportional to the calculated Franck–Condon factors for the system. Author

N65-27421# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
A HIGH REGULATION ION GAUGE POWER SUPPLY
J. S. Knoll 25 May 1960 8 p
(Contract AF 49(638)-591)
(RR-403FD428-R4; AD-611208)

A procedure to monitor minute ion current changes in an ion gage by a fast-response recording galvanometer is presented. To make these recordings, it was necessary to regulate the electron emission current against system pressure changes, and to power the filament with highly regulated and filtered dc to prevent the induction of spurious ac signals at the ion collector which would mask small ion current changes. Operating potentials for the gage are recommended, and filament power requirements are listed for various electron emission currents. The dc filament emission ion gage supply is described, and the regulated power supply is diagramed. Normal and outgas operations are outlined. M.W.R.

N65-27437 Joint Publications Research Service, Washington, D. C.

UNDERWATER MOTION PICTURE PHOTOGRAPHY

Chun-jen T'ien *In its* Transl. on Communist China's Sci. and Technol., No. 189 22 Jun. 1965 p 1–4 Transl. into ENGLISH from K'o-hsueh Hua-pao (Shanghai), no. 3, Mar. 1965 p 62–63 (See N65-27436 16-04) CFSTI: $2.00

Presented is a synopsis on underwater motion picture photography which focuses on the influence of photographic and submarine technology on the development of this technique. Discussed are techniques used above and below the water. Considered in the discussion are camera, diving equipment, and film requirements; and inherent problems associated with light diffusion and refraction. S.C.W.

N65-27445 Joint Publications Research Service, Washington, D. C.

INFLUENCE OF CHARACTERISTICS OF THE OPTICAL SYSTEM OF C-180 CAMERAS ON DETERMINATION OF THE BRIGHTNESS AND POSITION OF AURORAS

Yu. A. Nadubovich *In its* Studies in Auroras 24 Jun. 1965 p 27–52 refs (See N65-27442 16-13) CFSTI: $3.00

Factors related to effective transmission and image scale in the C-180 automatic all-sky camera are evaluated. The camera is characterized by a complex mirror-lens objective consisting of two spherical mirrors and having an angle of view of 180°, a collimating lens, and a Jupiter-3 objective. This movie camera is one of the principal instruments used for recording auroras. With respect to the mirror part of the optical system, the factors influencing illumination of the frame, and allowance for the influence of distortion and vignetting, are discussed. For the camera part of the system, analysis covers allowance for atmospheric absorption, coefficient of relative distribution of illumination along the radius of a frame, absolute measurement of auroral brightness, and allowance for illumination distribution when working with the blackenings in negatives. Some comments on the method of frame-by-frame photometric study of ascafilms are included. J.M.D.

N65-27446 Joint Publications Research Service, Washington, D. C.

SOME FEATURES OF THE S-180-S SPECTRAL CAMERA

G. V. Starkov *In its* Studies in Auroras 24 Jun. 1965 p 53–62 refs (See N65-27442 16-13) CFSTI: $3.00

Some operating factors of the C-180-S patrol spectrograph, which was designed for spectrographic study of the arc of the celestial vertical with short exposures, are analyzed. Determination of normal slit width, investigation of the influence of slit width on the measured intensities of atomic lines and molecular bands, and calculated spectral sensitivity and spectral camera distortion curves, are presented. J.M.D.

N65-27541# Army Electronics Labs., Ft. Monmouth, N. J. Electronic Components Dept.

LIQUID HELIUM LEVEL INDICATOR

Thaddeus X. Szwajer and Russell Homer Feb. 1965 9 p refs (ECOM-2570; AD-614777)

A device to detect the level of liquid helium in stainless steel Dewar is described. Various alternate methods of liquid helium detection are described, as well as the method selected to measure the varying resistance of carbon at low temperatures. A meter-expanding circuit, utilizing a Zener diode, is shown to be an aid in metering the change of resistance. The problems involved in Zener diode metering circuits, including linearity and current versus voltage characteristics, are examined experimentally. The results indicated that the basic circuit, with some modification, could be used in other applications of meter expansion. Operation of the final instrument is described showing the advantages of its simple design. The result of trade-off of optimum values is shown. The electrical characteristics of the Zener diode make it suitable for discriminating between two slightly different input voltage levels. Author

N65-27614 Atomic Energy of Canada, Ltd., Chalk River (Ontario).

THERMOCOUPLE FAULT LOCATION BY TIME DOMAIN REFLECTOMETRY

D. B. Martin and A. J. Otter Feb. 1965 30 p refs (AECL-2224) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

The application of Time Domain Reflectometry for fault finding in thermocouple circuitry has been investigated. This technique consists of applying a fast rise pulse to the thermocouple and observing the reflections with a sampling oscilloscope. A metal sheathed thermocouple acts as a lossy transmission line; consequently, the reflected wave is nearly exponential. Extension wire is also lossy and, if unshielded, its stray capacitance and inductance affect the pulse propagation velocity. For accurate location, it is necessary to compare the fault reflection with a reference obtained from an identical sound thermocouple or from the same thermocouple at installation. If such a comparison is possible, we estimate that fault location is typically accurate to within ±10% for circuits with up to 75 ft of unshielded extension wire and 25 ft of sheathed thermocouple 1/16 in O.D. Author

N65-27615# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).

A PUSH-THROUGH CONTAMINATED CLOTHING MONITOR

A. R. Jones Feb. 1965 13 p refs (AECL-2245) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

A monitor, is described, which is designed to detect low levels of β-contamination on laundered clothes. It is provided with background compensation and can detect 4 nCi of strontium 90/yttrium 90 spread uniformly on coveralls with background exposure rates up to 150 μR/hour. If the background is expected to rise to 5 mR/hour the sensitivity must be reduced to 30 nCi of strontium 90/yttrium 90. Twelve garments can be monitored in a minute. Author

N65-27678*# National Aeronautics and Space Administration, Washington, D. C.

NONMAGNETIC TIME-OF-FLIGHT MASS SPECTROMETER, ITS CHARACTERISTICS AND APPLICATIONS

Hiroshi Tomita (Hokushin Electric Co.) May 1965 38 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Tokyo), v. 67, no. 11, 1964 p 63–72 (NASA-TT-F-9344) CFSTI: HC $2.00/MF $0.50 CSCL 20F

In the nonmagnetic time-of-flight spectrometer (TOF), the gas or vapor to be analyzed is introduced into an ion chamber, and is ionized by electron bombardment. The device allows high-rate, continuous analysis of mass spectra. The simplicity and versatility of the TOF are discussed. Operation of the Wiley type multiplier, recording, range, resolution, sensitivity, and accuracy of data are treated. Problem areas and the following applications are described: analysis of gas emanating from a gas chromatograph, tracing of a high-speed chemical reaction, ion decomposition and charge exchange study, ionic molecular reactions, high-temperature reaction thermodynamics, analysis of solids, analysis of gas in motion, chemical reactions, human breathing investigations and others. Author

N65-27700*# National Aeronautics and Space Administration, Washington, D. C.
APPLICATION OF INFORMATION THEORY TO PHOTOGRAPHIC SYSTEMS [O PRIMENENII TEORII INFORMATSII K FOTOGRAFICHESKIM SISTEMAM]
D. S. Lebedev Jun. 1965 26 p refs Transl. into ENGLISH from Zh. Nauch. i Priklad. Fot. i Kinematografii (Moscow), v. 10, no. 1, 1965 p 62–71
(NASA-TT-F-9387) CFSTI: HC $2.00/MF $0.50 CSCL 14E

The properties of photographic systems are described in the framework of information theory, since both messages and photographs involve transmission and storage of information, and a blurred picture can be regarded as an uninformative message. Although the analogy seems natural it is not considered useful. The basic concepts of quantity of information, entropy, and capacity, are measures of the effectiveness of coding and decoding, while the achievement of these processes by purely photographic methods is unlikely. The development of a criterion for accuracy in reproduction of images must be derived from biophysical methods of psychological investigations, rather than from study of information theory. J.M.D.

N65-27704*# National Aeronautics and Space Administration, Washington, D. C.
CAMERAS FOR PHOTOGRAPHING MISSILES IN HYPERSONIC FLIGHT [CAMERAS POUR PHOTOGRAPHIE DES PROJECTILES EN VOL HYPERSONIQUE]
M. Paques and M. Lecomte Jun. 1965 22 p refs Transl. into ENGLISH of a paper presented at the 1st Intern. Congr. on Instrumentation in Aerospace Simulation Facility, Paris, 28–29 Sep. 1964
(NASA-TT-F-9407) CFSTI: HC $1.00/MF $0.50 CSCL 14E

The Institut Franco-Allemand at Saint-Louis (France) launches 11-mm diameter models at hypersonic speeds, using for observation in flight: (1) spark cameras for shadow setting; (2) a camera with speed compensated by a rotating mirror, at better than 1 percent, for shadow setting and emitted light; (3) an experimental electronic shutter camera for emitted light. Finally, densitometric measurements enable processing of films. It is shown that diffraction and depth of focus set a minimum size to the spread function of an image point, whatever the adjustment or the type of camera may be, and the main relationships permitting evaluation of the actual spread function for a given task are described. Author

N65-27750# Fairchild Camera and Instrument Corp., Syosset, N. Y. Space and Defense Systems Div.
IMAGE INTERPRETATION CELL
[1965] 28 p
(Contract AF 30(602)-2882)
(AD-606895)

Equipment and organization of the image interpretation cell (IIC) is described. Information is given on the computer, multi-sensor viewer, air conditioner/heater, detail interpretation, plotter, tape recorder/playback, storage, gas turbine generator, communication, and mobilizer equipment. The purpose of the cell is to generate forward echelon, accurate intelligence data in the form of flash and immediate photo interpretation reports. It is a mobile, self-contained, deployable, and adaptable image data system. The IIC performs three basic functions: (1) preparation, retrieval and sequencing of data prior to analysis of the multi-sensor reconnaissance inputs; (2) detection, recognition, and interpretation of requested and bonus targets; and (3) conversion and reduction of raw intelligence data to usable or specified report form. Functional flow diagrams, showing the pre-receipt, and flash and immediate modes of operation, are included. L.S.

N65-27754# Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research.
DEVELOPMENT OF A QUADRUPOLE MASS SPECTROMETER Technical Report, Jun. 1963–Nov. 1964
C. K. Crawford and C. E. Woodward Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1965 57 p refs
(Contracts AF 33(616)-8353; AF 33(657)-10939)
(AFML-TR-64-400; AD-610100)

An electric quadrupole mass spectrometer has been developed to cover 1 to 400 amu in four ranges. The electronic circuits that supply voltages to the mass filter are capable of 50:1 spectral-range sweeps in 0.1 sec, but resolution over a wide sweep range is limited by nonlinearity in the control of the r-f voltage. Compensation reduces nonlinearity over a 10:1 sweep range from 4 to 0.4%. The electron-multiplier ion collector is operated as a particle detector to eliminate the effects of multiplier gain variations. High-speed circuits (resolving times $< 5 \times 10^{-8}$ sec) produce standard output pulses that are integrated in a linear ratemeter to determine the mean rate. Spectrometer resolution is limited by mechanical imperfections in the quadrupole lens: The highest observed value has been $m/\Delta m = 300$ measured at the 1% amplitude points. A fine structure on the mass lines is attributed to lens imperfections. Author

N65-27777# Teledyne Systems Corp., Hawthorne, Calif.
A FEASIBILITY STUDY OF A SOLID STATE ACCELERATION SENSING TECHNIQUE Final Report, Feb. 1963–Jan. 1964
Gerald L. Vick Wright-Patterson AFB, Ohio, Flight Dyn. Lab., Dec. 1964 56 p ref
(Contract AF 33(657)-10671)
(FDL-TDR-64-55; AD-610548)

This report documents the results of an investigation of the practical feasibility and performance capability of a miniature force balance accelerometer using the piezo-resistive effect for null detection, and the piezoelectric effect for force balancing. Prototype accelerometers utilizing these effects were built and tested to determine the performance potential of this approach. The electronics required for the operation of this sensing technique and for processing the acceleration information is discussed. Author

N65-27780# India. Dept. of Atomic Energy, Bombay. Health Physics Div.
A COUNTER FOR FAST NEUTRON DOSIMETRY
K. B. S. Murthy, G. Muthukrishnan, and C. M. Sunta Oct. 1964
(AEET/HP/D-1)

This report describes a proton recoil proportional counter designed for the purpose of fast neutron dosimetry. The energy response of the counter is made such that the counting efficiency varies as inverse of the current values of the maximum permissible flux (MPF) of fast neutrons of energies up to 14 Mev. This counter thus gives a fixed number of counts per maximum permissible flux of fast neutrons irrespective of their energy. Thick and thin layers of polythene and a commercial fuel gas Burshane are used as proton radiators. The energy response of the counter was verified with monoenergetic neutrons using Van de Graaf accelerator and cascade generator. The observed response is found to be very close to the required response. The sensitivity was found to be 34 cpm/MPF for counters with diameter 3.6 cms and length about 25 cms. Using Burshane and argon, the proportional counters with required response could be operated at much lower voltage as compared to counters using methane, which is of convenience in making a portable dosemeter. The counter is found insensitive to gamma rays. Its thermal neutron sensitivity also is negligible. Author

N65-27827# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
MARINER C-64: TRAPPED RADIATION DETECTOR, UNIT 25 Final Engineering Report, 17 May 1963–30 Dec. 1964
R. H. Gabel and J. Skerik 19 Feb. 1965 163 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950613)
(NASA-CR-63743) CFSTI: HC $5.00/MF $1.00

Presented is a technical description of the Mariner C Program, which focuses on the design, fabrication, and testing, of the following models of a trapped radiation experiment: (a) Thermal Control Model (TCM), (b) Engineering Prototype/Type Approval (EP/TA), (c) Proof Test Model (MC-1), (d) First Flight Unit (MC-2), (e) Second Flight Unit (MC-3), (f) Flight Spare (MC-4), and (g) MC-5. The MC-2 experiment was launched aboard the MC-2 spacecraft (Mariner-3) on 5 November 1964. The mission was unsuccessful although the experiment operated properly. MC-3 was launched aboard the MC-3 spacecraft (Mariner-4) on 28 November 1964. It has operated properly through 19 February 1965. Included are extensive data on design criteria, bench checkout equipment, and documentation. S.C.W.

N65-27865# Technical Operations Research, Burlington, Mass.
DRY PROCESSING TECHNIQUE Final Report, 27 Feb. 1964–30 Apr. 1965
Allan Shepp, Ignatius E. Theodorou, Ralph J. Shuman, William G. Kammerer, David L. Davidson et al Jun. 1965 38 p refs
(Contract AF 33(615)-1548)
(AFAL-TR-65-135; AD-465434)

Chemical-mechanical systems that release photographic processing solutions from a totally dry stable state and apply these solutions to exposed photographic film for processing are studied. In one system, developer or monobath solutions are suspended in a stable plastic medium that is coated on the rim of an applicator wheel. The solution is released upon command and applied to the film by a mechanical rotary process. A prototype processor has been built to be fitted with a wheel that can process 50 ft of exposed film. Using Ansco Hyscan film, development occurs in 5 to 10 sec, at 70° F, to characteristics comparable to a wet developed control. In another system, a three-layer imbibed emulsion is prepared that is dry and stable. Liquid developer is thermally released at 85° C *in situ*, to cause rapid development of the emulsion layer. It was concluded that imbibed or wheel applicator processing is superior to processing with a separate matrix. Author

N65-27905# Bendix Corp., Davenport, Iowa. Pioneer-Central Div.
AN IMPROVED ALTITUDE COMPUTER
C. Johanson, V. Z. Peterson, and D. Rogness Wright-Patterson AFB, Ohio, Systems Eng. Group, Dec. 1964 32 p
(Contract AF 33(600)-42848)
(SEG-TR-64-70; AD-610508)

This report describes the design, development, and prototype construction of an instrument which provides accurate corrected pressure altitude outputs. The corrected pressure altitude outputs consist of a fine and coarse autosyn transmitter signal, provided to drive altitude indicators, and a Moa Gilham coded shaft position encoder output intended to provide the altitude signal for altitude reporting. A major achievement with the instrument is the 20 foot accuracy obtained from −1000 to 10,000 feet and the 0.2% accuracy from 10,000 to 80,000 feet. Another achievement is the extent of correction of the static pressure defect characteristic of the aircraft, in the transducer through the range of .2 to 3.0 mach number, for the altitude range of −1000 to 80,000 feet. An interchangeable cam arrangement for the static pressure defect correction permits the altitude computer to be adapted to many types of aircraft. Total elapsed time is recorded on an internal counter visible through a glass window and signal monitoring circuits provide signals for failure warning. The instrument is designed with temperature compensation and vibration and shock isolation. Inputs of static pressure and total pressure are required from the aircraft pressure system. In addition, 115V 400 cps power is required from the aircraft electrical system. The unit is packaged in a volume of 6" × 6" × 8" and weighs 10 lbs. Author

N65-27910# Aeronautical Chart and Information Center, St. Louis, Mo. Cartography Div.
TERRAIN-EMBOSS: ITS APPLICATION TO SHADED RELIEF PRODUCTION BY RELIEF MODEL PHOTOGRAPHY
G. E. Bebermeyer Oct. 1964 34 p refs
(ACIC-TR-104; AD-610582)

A simplified hand-tooling technique for model making has for some years been under development at the Aeronautical Chart and Information Center for the primary purpose of improving production of shaded relief portrayal on USAF charts. Basic concepts, some of the tests made, problems experienced which preceded adaptation of Terrain-Emboss to shaded relief portrayal, and an evaluation of the technique as compared to present hand-airbrush and other known model-making methods, are discussed. Author

N65-27918 Hewlett-Packard Co., Colorado Springs, Colo.
CABLE TESTING WITH TIME DOMAIN REFLECTOMETRY Application Note
May 1965 17 p *With* Time Domain Reflectometer Calculator (HP-AN-67)

A type of closed-loop, one dimensional radar system apparatus, in which the transmitted signal is a fast step function and the reflected signals are monitored on the oscilloscope screen, is described. The time domain reflectometer (TDR) may be conveniently used to measure the classic propagation characteristics of a transmission line, α, β, and Z_0. However, these constants will vary along the line, and a given section may have different characteristics. The TDR isolates such variations in time (distance), providing an impedance profile along the length of the line. A given cable may be 100% tested by a single measurement. Accuracy and resolution are among other aspects discussed. The second reflection correction factor chart shows that measurements will be accurate if reflections in the early part of the system are low. It is advisable to use a two to three foot length of air line or very good cable between the TDR and the test circuit. R.W.H.

N65-27922# Royal Aircraft Establishment, Farnborough (England).
A SUB-MINIATURE DIFFERENTIAL PRESSURE TRANSDUCER FOR USE IN WIND TUNNEL MODELS
W. R. Mac Donald and P. W. Cole London, Min. of Aviation, Jan. 1961 32 p refs
(RAE-TN-INSTN-169)

This Note describes the development of a differential pressure transducer of exceptionally small size, (1/4 × 1/4 × 1/8 inch), primarily for use in small wind tunnel models. Its operation is based on a push-pull capacitance change and it is used in conjunction with a special A.C. bridge-amplifier. With a range of ± 4 lb/in^2 it has a rise time of about 20 microseconds. Zero shift and sensitivity variation over a temperature range of −40° C to +70° C are less than 0.15% per degree centigrade, and the sensitivity to acceleration is less than 0.02% per "g". A small number of tranducers have been made and successfully tested in wind tunnel and shock tube applications, and commercial production of transducers and associated amplifiers has been initiated. Author

N65-27945*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT EVALUATION OF THE X-15 BALL-NOSE FLOW-DIRECTION SENSOR AS AN AIR-DATA SYSTEM
John P. Cary and Earl R. Keener Washington, NASA, Jul. 1965 21 p refs
(NASA-TN-D-2923) CFSTI: HC $1.00/MF $0.50 CSCL 14B

An X-15 ball-nose flow-direction sensor was modified to investigate its suitability for air-data measurements of Mach number and pressure altitude. A static-pressure port was added to the nulling sphere at an angle of 70° to the free-stream flow. The static port was calibrated to measure Mach number and pressure altitude in the Mach number range from 0.3 to 5.3 at altitudes up to 130,000 feet and at Reynolds numbers from 0.1 to 1.6 × 10^6 per foot. Dynamic pressure was accurately determined from ball-nose stagnation pressure for Mach numbers up to 5.6 and altitudes up to 180,000 feet. As shown by this investigation, the capability of the modified flow-direction sensor would probably be limited to Mach numbers less than about 4.5 because of the decreasing sensitivity of the system to changes in Mach number and the increasing influence of nulling error. For an on-board system, the percentage error in Mach number, and the calculation of dynamic pressure from ball-nose stagnation pressure can be assumed independent of speed if the free-stream Mach number is greater than 2.5. Ball-nose lip interference resulted in inaccuracies for a small portion of the flight regime investigated. Author

N65-27958*# Rochester Univ., N. Y.
OPTICAL DESIGN Interim Progress Report, Dec. 1, 1964–Feb. 28, 1965
Richard Mostrom and Neil Hochgraf [1965] 15 p ref
(Contract NASr-14)
(NASA-CR-63774) CFSTI: HC $1.00/MF $0.50 CSCL 20F

Continued research under a program designed to develop optical instrumentation suitable for incorporation into an orbiting astronomical observatory is reported. Presented are data from analyses of wide grating, tall narrow grating, tall decentered grating, and a procedure for distorting the grating blank by pinching. Progress on the construction and assembly of the vacuum and optical systems to be used for grating calibration and evaluation measurements is cited. S.C.W.

N65-27961# Technical Operations Research, Burlington, Mass.
RELATIVE ADVANTAGES OF INTERFEROMETER OVER TELESCOPE FOR MEASURING SOURCE SIZES Final Report, 15 Nov. 1963–31 Jan. 1965
Helmut Hecksher and George O. Reynolds 5 Mar. 1965 92 p refs
(Contract AF 19(628)-3871; ARPA Order 450)
(TO-B-65-19; AFCRL-65-179; AD-614248)

In this report an analysis of the Michelson stellar, Fizeau double-slit and the folding interferometers is given and their relative merits are compared to a telescope for performing source size measurements. The atmospheric effects upon these instruments are examined. Experimental procedures describing the use of the Michelson stellar interferometer are given. Experimental difficulties encountered in the program are also discussed. It is concluded that interferometers are a better instrument than telescopes for source size measurements in the presence of a turbulent atmosphere if information about the source geometry and intensity distribution is available. When the source geometry and intensity distribution are not known, then none of the instruments give an absolute source size measurement under turbulent conditions. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-26916 Joint Publications Research Service, Washington, D. C.
THE AIR COMPRESSOR
Hsiao Ting *In its* Transl. on Communist China's Sci. and Technol. No. 190, 23 Jun. 1965 p 8–13 Transl. into ENGLISH from Hang-K'ung Chih-Shih (Communist China), no. 3, Mar. 1965 p 24–25 (See N65-26914 16-34) CFSTI: $1.00

The principle of the centrifugal and axial flow air compressors is discussed. Advantages and disadvantages of both types are given. It is noted that the axial flow air compressor shows less loss and greater efficiency; however, its structure is more complex, production is more difficult, and the cost is higher. The centrifugal compressor has a simple structure, production costs are low, and it is well suited for mass production. E.E.B.

N65-26944# FMA, Inc., Los Angeles, Calif.
A STUDY OF SPRAY PROCESSING TECHNIQUES USING LIQUID AND AIR BEARINGS Final Documentary Report, Nov. 1963–Nov. 1964
Jack Robe and Onni Niemi Wright-Patterson AFB, Ohio, AF Avionics Lab., Mar. 1965 194 p
(Contract AF 33(615)-1003)
(AFAL-TR-65-16; AD-461111)

The program was undertaken to develop techniques for processing wide photographic films to precise densities (6% in a 250-foot roll) with gamma tolerances of ±3% and aggregate developed image uniformities of 0.2 across the film width. The processing was conducted in spray chambers for which special components were developed in order to provide low tension non-contact film passage through the wet section. Mathematical analysis of the various components are augmented by test results of models and includes a study of optimum spray locations, together with descriptions of individual components and their capabilities. Specific areas include: 1) a hydrodynamic bearing capable of transporting wide films over a range of transport speeds while permitting ease of startup; 2) a unitized air bearing suitable for stationary or movable operation; 3) optimum spray tip spacing; 4) dryer requirements; and 5) practical upper limit for transport speeds associated with a film processing system using the foregoing elements (154 feet/minute). This report also includes a recommended film processor which is suitable for clean room operation and which provides improved access, reduction of heat losses, and a design concept which minimizes the use of corrosive resistant steels. Author

N65-26964# California Univ., Livermore, Lawrence Radiation Lab.
PROCESS STREAM ANALYSIS SYSTEMS FOR THE SCRUBBER SOLUTIONS USED IN THE PROJECT DRIBBLE VENT GAS TREATMENT PLANT
Lester P. Rigdon and Jackson E. Harrar 10 May 1965 25 p refs
(Contract W-7405-ENG-48)
(UCRL-14123) CFSTI: $2.00

Analytical systems are described which provided control information for the Project Dribble vent gas treatment plant.

Technicon Instruments Company's AutoAnalyzer equipment was used for continuous monitoring of the components of the plant scrubber solutions. Methods were developed and adapted for the continuous determination of OH^- and $CO_3^=$ in the concentration range of 0.05 to 1.5 *N*; and $SO_3^=$, Cl^-, and $SO_4^= + SO_3^=$ in the range of 0.05 to 3.5 *N*. The continuous analysis system was incorporated into a glove-box enclosed, trailer-housed facility which also included a capability for manual analyses and pH determination. The performance of this installation with the vent gas treatment plant is characterized. Author

N65-26975# Joint Publications Research Service, Washington, D. C.
STUDIES IN ELECTROSLAG PROCESSES
21 Jun. 1965 15 p refs Transl. into ENGLISH from Russian Periodicals
(JPRS-30716; TT-65-31303) CFSTI: $1.00

CONTENTS:

1. ELECTROSLAG WELDING OF VTIO TITANIUM Ya. Yu. Kompan p 1–4 refs (See N65-26976 16-15)
2. IMPROVING THE MACROSTRUCTURE OF ELECTROSLAG STEELS Yu. I. Zabaluyev et al p 5–10 refs (See N65-26977 16-17)
3. ELECTROSLAG SURFACING OF CUTTING TOOLS M. I. Gryazev and V. I. Svetlopolyanskiy p 11–13 (See N65-26978 16-15)

N65-26976 Joint Publications Research Service, Washington, D. C.
ELECTROSLAG WELDING OF VTIO TITANIUM
Ya. Yu. Kompan *In its* Studies in Electroslag Processes 21 Jun. 1965 p 1–4 refs Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 4, Apr. 1965 p 50–52 (See N65-26975 16-15) CFSTI: $1.00

Examinations were made on the welding of titanium-alpha alloy and a basic technology for the electroslag welding of rectangular shaped test specimens of this alloy was developed with the application of a laminated electrode. Welds made by laminated electrodes of an alloy of the system titanium–aluminum–vanadium gave a satisfactory toughness, ductility, and impact strength in the range from 20° to 550° C with a content of 4 to 5% aluminum and 2.3 to 2.9% vanadium in the weld metal. The laminated electrode composition of 4 to 4.8% aluminum and 3.6 to 4.5% vanadium was recommended. The weld was without bubbles, cracks, slag inclusions, and contamination by gases. E.E.B.

N65-26978 Joint Publications Research Service, Washington, D. C.
ELECTROSLAG SURFACING OF CUTTING TOOLS
M. I. Gryazev *In its* Studies in Electroslag Processes 21 Jun. 1965 p 11–13 Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 4, Apr. 1965 p 57–58 (See N65-26975 16-15) CFSTI: $1.00

Investigations were made to determine the possibilities of building a layer on the cutting tool holders which would have a red hardness, good resistance against impact loads, and a high degree of resistance to wear. A grit of ferroalloys with diameters ranging from 0.2 to 1.0 mm was used for the surfacing mixtures. The graphite-containing charge was thoroughly mixed and liquid glass introduced. The material was initially air dried for 10 to 12 hours at 20° C and then dessicated at 150° to 200° C for 1.5 to 2.0 hrs. The experimental surfacings were made on cutting tool holders of standard sizes of ordinary carbon steel. After the surfacing was completed, the tools were subjected to homogenization at 850° to 900° C and hardened. The hardness of the built-up surfaces was 62 to 66 R_c. No cracks, pores, or slag inclusions were revealed in these surfaces by macro- or microstructure examination. The tools were more durable and less sensitive to impact loads. E.E.B.

N65-26988# Battelle Memorial Inst., Columbus, Ohio.
A SURVEY OF ELECTROFORMING FOR FABRICATING STRUCTURES
W. H. Safranek Huntsville, Ala., RSIC, Oct. 1964 44 p refs Revised
(Contract DA-01-021-AMC-203(Z))
(RSIC-210; AD-461826)

Several high-strength structures have been produced by electroforming, for specific missile and aerospace applications. Several organizations have electrofomed nickel with ultimate tensile strengths of 90,000 to 100,000 psi, or more. Tough (notch insensitive), 200,000-psi nickel has been electroformed by one or two organizations, but additional information must be developed before such a high strength material can be electroformed consistently in a complexly shaped form. This state-of-the-art report describes advantages and limitations of electroforming, summarizes available property data of materials, and discusses electroforming conditions that must be maintained for good control of structural properties. Author

N65-27081# Beryllium Corp., Reading, Pa.
PRODUCTION ENGINEERING MEASURE FOR BERYLLIUM OXIDE AND PARTS PRODUCED FROM IMPORTED ORES Quarterly Progress Report, Oct. 1–Dec. 31, 1964
J. F. Blum and Harold F. Lebo [1964] 37 p
(Contract DA-36-039-AMC-01481(E))
(QPR-6; AD-615412)

The study of powder sinterability as a function of average particle size was continued this quarter. A complete summary shows that average particle size, at this point of development, cannot be used on a control basis to accurately predict sinterability in the range of 1.7-2.8 micron average. However, a general correlation does exist, and reasonable predictions can be made at the extremes. In general, the average particle size should be maintained close to 1.7 microns to obtain a highly active powder, but coarser powder can still be fabricated to acceptable density. Two of the four parts required for the contract were fabricated employing the process developed during this study. The parts were pressed and sintered to the required dimensions with no difficulty. Final firing shrinkage was accurately controlled by controlling green and final fired density. Beryllium sulfate crystals were prepared to initiate the final four pilot plant powder uniformity runs. The crystals met all applicable specifications. Author

N65-27089# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.
CONTROL AND REPRODUCIBILITY OF FERRITES PREPARED BY THE FLAME SPRAY-HOT PRESS TECHNIQUE
Richard W. Babbitt and Walter W. Malinofsky Apr. 1965 22 p refs
(ECOM-2563; AD-615807)

The flame spray and hot press apparatus are described. Various flame spray parameters and their effects are discussed. Reproducibility of physical and magnetic properties of ferrites due to the hot press alone and the flame spray-hot press combination are presented. It is shown that reproducibility by this technique compares favorably with conventional techniques. Author

N65-27163# Rotron Mfg. Co., Woodstock, N. Y.
DEVELOPMENT OF A GAS LUBRICATED BEARING BLOWER ASSEMBLY FOR USE IN AN AN/TED-9 RADIO TRANSMITTER Interim Development Report, 3 Feb.–30 Apr. 1965
[1965] 44 p
(Contract NOBsr-87522)
(AD-615820)

Development continued on a hydrodynamic gas lubricated blower motor for use in cooling an AN/TED-9 radio transmitter. Test rig investigations were conducted to determine the effect of motor radial magnetic loads on the performance of hydrodynamic type bearings. Results indicated that the magnetic forces due to an eccentric magnetic airgap can be of the same magnitude as the rotor weight in low horsepower motor blowers. Observed force levels correlated closely with predicted values. Half-frequency whirl threshold appeared lower under the influence of the magnetic loads and may be due to the vibratory nature of the magnetic load which occurs at twice line frequency. The first development gas bearing blower prototype was assembled and operated satisfactorily. A transistorized converter for use in driving the blower motor is discussed.
R.N.A.

N65-27164# Naval Ordnance Test Station, China Lake, Calif. Propulsion Development Dept.
THE APPLICATION OF ULTRASONICS TO WIRE DRAWING Quarterly Progress Report, 1 Oct.–31 Dec., 1964
A. T. Robinson, J. C. Connelly, and L. M. Stayton Mar. 1965 9 p
(TPR-390; NOTS-TP-3768; AD-615509)

Hardness and tensile strength measurements were performed on titanium, copper and iron wire drawn with and without ultrasonic radiation. The results show that less work-hardening was induced during deformation when radiation was present. Temperature measurements made at the die bearing surface disclosed only a minor temperature rise for a given set of conditions. The continuous drawing equipment has been placed in operation and performs satisfactorily.
Author

N65-27209# IIT Research Inst., Chicago, Ill. Technology Center.
METHODS FOR PREDICTION OF ELECTRO-MECHANICAL SYSTEM RELIABILITY Semiannual Report, 15 May–14 Nov., 1964
Thomas L. Bush, Anthony P. Meyers, and Darwin F. Simonaitis [1964] 66 p refs
(Contract DA-28-043-AMC-00093(E))
(Rept.-1)

The objective of this program is to develop methods, relationships, and/or guidelines for evaluating and predicting, during the design stage, the reliability of those types of military equipments which make extensive use of both electronic and mechanical components. During this report period, program effort was concerned with three major areas. The first area, failure mechanics, was concerned with the basic mechanics and material factors which influence mechanical reliability characteristics. Specific topics investigated in this area include the evaluation of the effects of a mean stress superimposed upon a fluctuating stress on fatigue life characteristics, and the evaluation of fatigue damage effects. The second area was concerned with the study of specific mechanical parts. In this case, the major factors affecting spring reliability characteristics are discussed. The third area involved the system reliability aspect. Here, the basic concepts of the system reliability effort have been developed. The system reliability effort in this program is concerned with the system-component relationships applicable to system reliability analysis, and with the most effective utilization of available reliability oriented information at both the part and system levels in developing a comprehensive electro-mechanical reliability evaluation methodology.
Author

N65-27295*# Kulite Tungsten Co., Ridgefield, N. J.
RESEARCH ON SINTERED POROUS RESTRICTORS Final Status Report
20 Apr. 1965 69 p
(Contract NAS8-11413)
(NASA-CR-63468) CFSTI: HC $3.00/MF $0.75 CSCL 13H

Manufacturing procedures for reducing production costs on tungsten rods are being developed. Porous tungsten restrictors were produced with flow rates as low as 5 to 10 cc per minute or as high as 300 cc per minute. Several steps in the sintering and grinding operation were eliminated resulting in a more economical and efficient operation with no appreciable loss in control. A hydrostatic pressing method which produced round tungsten bars eliminates rough grinding, requires no lubricant or binder, and results in better green density distributions than other methods of pressing. A double acting die was incorporated into the normal production of tungsten bars. Restrictors were produced from spherical tungsten powder. Electron beam sealing parameters were investigated and data compiled of their effects on yield and properties. Flame sprayed copper on tungsten rods was used as a substitute for electron beam sealing.
R.N.A.

N65-27320# SKF Industries, Inc., King of Prussia, Pa. Research Lab.
A BASIC STUDY OF THE SLIDING CONTACTS IN ROLLING BEARINGS Progress Report No. 4, Jan. 17–Apr. 16, 1965
C. J. Belsky, J. I. Mc Cool, J. T. Walker, J. A. Kamenshine, K. Tataiah et al [1965] 116 p refs
(Contract NOw-64-0428-c)
(AL65L032; AD-615128)

Kinematics of rollers in a cylindrical roller bearing were further investigated using two distance gages mounted at a spacing of 30° central angle. The output from these probes was tape recorded, the signals sampled, the sample amplitudes digitized and computer processed. Averages and standard deviations were obtained of the skew angle under both probes, the axial roller position under both probes, and the axial displacement of the roller between the two probes. Correlation coefficients were calculated between skew angles under the first and second probes, and between skew angle under the first probe and axial motion of the roller between the two probes. From these data, the angular position and axial motion of the rollers has been analyzed in the load zone entrance region. It was found that in an essentially aligned, radially loaded cylindrical roller bearing, rollers arrive to the load zone in widely scattered angular and axial positions, and that most rollers are not in flange contact. Due to residual misalignment in the bearing, average skew angles for the roller set are significantly different from zero.
Author

N65-27350# Joint Publications Research Service, Washington, D. C.
SOVIET CONFERENCES ON METALS AND METALLURGY
8 Jun. 1965 50 p Transl. into ENGLISH from Russian Periodicals
(JPRS-30496; TT-65-31207) CFSTI: $2.00

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3. REPUBLIC CONFERENCE ON THE THEORY AND PRACTICE OF OXYGEN CONVERTER PROCESSES N. P. Konashko p 17–21 (See N65-27352 16-15)

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5. CONFERENCE ON HIGHLY PRODUCTIVE METHODS OF WELDING IN CHEMICAL AND PETROLEUM MACHINE BUILDING A. N. Safonnikov and S. V. Yunger p 24–32 (See N65-27353 16-15)

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7. ALL-UNION CONFERENCE ON DISLOCATIONS AND MECHANICAL PROPERTIES OF CRYSTALS M. V. Klassen-Neklyudova p 41–47 (See N65-27354 16-26)

N65-27351 Joint Publications Research Service, Washington, D. C.

CONFERENCE ON PROCESSES OF CRYSTALLIZATION AND STRUCTURAL TRANSFORMATIONS IN WELDED JOINTS WITH RESPECT TO THE IMPROVEMENT OF THEIR QUALITY

V. U. Lyubavskiy *In its* Soviet Conf. on Metals and Met. 8 Jun. 1965 p 10–16 Transl. into ENGLISH from Svarochn. Proizv. (USSR), no. 2, Feb. 1965 p 44–45 (See N65-27350 16-15) CFSTI: $2.00

Brief abstracts are given on the subject of crystallization and structural transformations during and after welding. Among the specific conclusions in the papers reviewed were the following: (1) The average crystallization rate has its minimum at the fusion boundary and its maximum in the central part of the welded seam. (2) A material's resistance to hot crack formation during welding is determined by its minimum plasticity. (3) Austenitic steels are softened and become more brittle under the influence of the thermal cycle in the welding operation. Subsequent heat treatment does not restore the properties of the material in the heat affected zone. (4) The addition of zirconium and cerium to welded seams containing bismuth and lead does not eliminate hot cracks. E.E.B.

N65-27352 Joint Publications Research Service, Washington, D. C.

REPUBLIC CONFERENCE ON THE THEORY AND PRACTICE OF OXYGEN CONVERTER PROCESSES

N. P. Konashko *In its* Soviet Conf. on Metals and Met. 8 Jun. 1965 p 17–21 Transl. into ENGLISH from Met. i Gornorudn. Prom. (Kiev), no. 1, Jan.–Feb. 1965 p 75–76 (See N65-27350 16-15) CFSTI: $2.00

Brief abstracts are presented for a few of the articles given at the conference. Among these were the following: (1) converter processing of phosphorus and natural alloyed cast iron; (2) mechanism and kinetics of the oxidation of carbon; (3) oxidizing processes and the control of oxygen converter smelting; (4) converter linings; (5) steel production; (6) vanadium cast iron production; (7) smelting of steel in 100-ton converters. The conference resolved that further improvement in oxygen-converter technology for steel smelting would be supported. E.E.B.

N65-27353 Joint Publications Research Service, Washington, D. C.

CONFERENCE ON HIGHLY PRODUCTIVE METHODS OF WELDING IN CHEMICAL AND PETROLEUM MACHINE BUILDING

A. N. Safonnikov and S. V. Yunger *In its* Soviet Conf. on Metals and Met. 8 Jun. 1965 p 24–32 Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 12, Dec. 1964 p 84–87 (See N65-27350 16-15) CFSTI: $2.00

Brief abstracts of articles presented at the conference are given. Among the subjects covered are the following: structural transformations in welded joints, crystallization rates in cast iron; cold and hot crack formation; corrosion resistant steels; aluminum welding, welding of austenitic steels; neutron diffraction for weld analyses; welding of enameled steel; and plasma-arc cutting of metals. E.E.B.

N65-27355# Joint Publications Research Service, Washington, D. C.

ELECTRO-EROSION MACHINING

16 Jun. 1965 17 p Transl. into ENGLISH from Mashinostr. (Kiev), no. 2, Mar.–Apr. 1965 p 38–44
(JPRS-30650: TT-65-31278) CFSTI: $1.00

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1. ELECTRO-EROSION MACHINING A. I. Alekseyev p 1–10 (See N65-27356 16-15)

2. ELECTRODES FOR ELECTRO-EROSION MACHINING OF METALS G. L. Dubrov and A. V. Mamay p 11–14 (See N65-27357 16-15)

N65-27356 Joint Publications Research Service, Washington, D. C.

ELECTRO-EROSION MACHINING

A. I. Alekseyev *In its* Electro-Erosion Machining 16 Jun. 1965 p 1–10 (See N65-27355 16-15) CFSTI: $1.00

The machining of metals by electroerosion is described. Three electroerosion techniques are identified: the anodic-mechanical method which is used for blanking operations with a strip cutting anodic-mechanical machine tool; the electric pulse method which is used basically for preliminary machining of magnet alloys and also in cutting out samples of current-conducting bars for metallographic examination; and an electric spark method employed in machining current-conducting parts whose hardness is not less than HRC 45. J.M.D.

N65-27357 Joint Publications Research Service, Washington, D. C.

ELECTRODES FOR ELECTRO-EROSION MACHINING OF METALS

G. L. Dubrov and A. V. Mamay *In its* Electro-Erosion Machining 16 Jun. 1965 p 11–14 (See N65-27355 16-15) CFSTI: $1.00

A process was developed for manufacturing metal-ceramic electrodes for reaming shaped slots and for smooth machining of forging dies. Best results were obtained with copper-graphite and copper-aluminum electrodes. The process consists of preparing the batch by mixing the powders, pressing them on hydraulic presses, drying in order to remove the glycerine, baking in an atmosphere of dissociated ammonia, and final gaging. The productive capacity of electroerosion machining with metal-ceramic electrodes is raised in the case of electric-impulse operation by 25% as compared to copper electrodes, by 100% as compared to graphitized electrodes, and by 150–200% in the case of electric-spark operation. These electrodes are characterized by high resistance and stability and low manufacturing cost. J.M.D.

N65-27368*# Sperry Farragut Co., Bristol, Tenn.

DESIGN, DEVELOPMENT, AND FABRICATION OF A REACTION WHEEL UTILIZING A BRUSHLESS MOTOR

6 May 1965 36 p *Its* Publ.-3100-R520
(Contract NAS5-9016)
(NASA-CR-63591) CFSTI: HC $2.00/MF $0.50 CSCL 13I

Reliable, efficient, lightweight, sealed brushless dc reaction wheel systems are described. Reaction wheel system development included a deflection test for comparison of a flywheel with webs and one without webs; results show greater

deflection for the flywheel without webs. In another test, webs from one flywheel were removed resulting in an overall weight reduction of .16 lbs. Design effort on breadboard tests of motor and electronics developments included tachometer and commutator design; regenerative braking circuits including control circuitry; bidirectional rotational when commanded by two separate 4 V dc signals; and photosensor mounting configuration for higher current output. An analysis of ripple torque caused by commutation was made for a delta winding configuration and a Wye winding configuration. The possibility of constructing an armature winding which would produce a counter EMF wave form that is relatively flat over a 60 degree commutating zone was explored. It was demonstrated that the terminal voltages of delta and Wye connected windings do not have a third harmonic which is the major influence in wave flattening. An attempt was made to utilize the fifth harmonic of flux as a means for flattening the terminal voltage wave.
R.W.H.

N65-27385*# Technidyne, Inc., West Chester, Pa.
MONTHLY PROGRESS REPORT NO. 6, APR. 10–MAY 10, 1965
P. G. Luckhardt 11 May 1965 5 p
(Contract NAS5-9006)
(NASA-CR-63605) CFSTI: HC $1.00/MF $0.50 CSCL 13H

The microscopic examination of the lapped, ground, and replated precision flat packs and retesting for helium leakage, located points of maximum leakage at the corners. Welding studies established machine settings required for welding gold-plated Kovar covers to the precision flat packs. Preferential bonding occurred at the corners because of the flat pack geometry. The addition of a ductile interleaf and increased welding time resulted in good bonding over the entire periphery. Metallographic evaluation of a sample without an interleaf revealed unequal thicknesses of plating on the covers and the frames of the flat packs. Assembly of the 28-kilocycle ultrasonic ring welder for higher-frequency welding studies is almost complete and the terminal coupler was fabricated.
R.N.A.

N65-27391*# Boeing Co., Seattle, Wash.
IDENTIFYING OPTIMUM PARAMETERS OF HOT EXTRUSIONS Interim Report
R. W. Rice and J. G. Hunt 3 May 1965 96 p refs
(Contract NAS7-276)
(NASA-CR-63598) CFSTI: HC $3.00/MF $0.75 CSCL 11H

The technique for hot extruding MgO, CaO, and ZrO_2 was investigated. It was found that extrusion in thick walled cans was more successful then extrusion in thin metal shells. Also, tungsten cans gave little reaction or contamination with MgO rich bodies; however, TZM molybdenum alloy reacts with CaO and possibly ZrO_2. Techniques to extrude in split and slotted cans and shells proved successful and reduced ceramic removal. CaO and ZrO_2 bodies were extruded after heating to 2000° C and MgO was successfully extruded above 2100° C. Lubrication of the can or shell proved adequate if extrusion speeds were greater than 2 inch/sec. Reduction ratios of 9:1 and 13:1 were achieved. Increased orientation and a limited reduction in grain size result from increased reduction ratios. Further, MgO and CaO showed substantial orientation as a result of extrusion. Alloys such as MgO–CaO and MgO–ZrO_2 require higher extrusion pressures or temperatures, have smaller grain sizes, and less orientation than single phase systems such as MgO. Also, second phase alloys generally had greater homogeneity after extrusion.
E.E.B.

N65-27392*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EFFECT OF SPEED, LOAD, AND TEMPERATURE ON MINIMUM-OIL-FLOW REQUIREMENTS OF 30- AND 75-MILLIMETER-BORE BALL BEARINGS
Zolton N. Nemeth and William J. Anderson Washington, NASA, Jul. 1965 17 p refs
(NASA-TN-D-2908) CFSTI: HC $1.00/MF $0.50 CSCL 13I

Minimum-oil-flow tests were conducted with 30-millimeter-bore, deep-groove ball bearings over a DN range (product of bearing bore in mm and shaft speed in rpm) of 0.825×10^6 to 0.975×10^6 and a temperature range of 170° to 400° F at a thrust load of 265 pounds with naphthenic-mineral-oil-air mist lubrication. Minimum required oil flow for continuous operation increased with increasing DN and bearing temperature. This increase agreed with previously published data for 75-millimeter-bore bearings. A generalized correlation of the data obtained herein and with the 75-millimeter-bore bearing indicates that minimum required oil flow can be expressed as a single function of bore size, load, DN, and bearing temperature. The correlation was developed for 30- and 75-millimeter-bore bearings at thrust loads of 265 to 3000 pounds, DN values of 0.6×10^6 to 0.975×10^6, and temperatures of 225° to 500°F. Airflow, which was controlled independently of oil flow, was found to affect the minimum required oil flow at specific operating conditions. Airflow apparently affects the efficiency with which the bearing can utilize the oil droplets fed to it, and there appears to be an optimum mist velocity for a given DN or rotative speed.
Author

N65-27534# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TECHNIQUE OF MAKING A CUTTING TOOL WITH BRAZED HARD ALLOY TIPS
V. N. Artsimovich, E. M. Partikeyeva, I. A. Tokarev, and I. I. Yanovskiy 7 Apr. 1965 4 p Transl. into ENGLISH from Russian Patent No. 144559 (Appl. No. 761828/22-2, Jan. 25, 1962)
(FTD-TT-65-297/1; AD-614771)

The technique for making cutting tools with brazed, hard alloy tips is distinguished by the fact that, in order to reduce internal stresses in the braze zone and to increase durability, the tool is subjected to cold hardening at a temperature of −100 to −183° after the hard alloy tip has been brazed on.
Author

N65-27535# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF PULSE WELDING AND FACING WITH A VIBRATION ELECTRODE
G. A. Marlin 7 Apr. 1965 4 p Transl. into ENGLISH from Russian Patent No. 153760 (Appl. No. 601395/25, Jun. 9, 1958)
(FTD-TT-65-298/1; AD-614772)

This method of pulse welding and surfacing with a vibration electrode under flux or in a medium of protective gases, during which electrode vibration is accomplished synchronously with weld-current pulses, is distinguished by the fact that in order to broaden the range of possible regimes and to enhance weld quality, weld pulses are generated by modulation or interruption of the current with regulation of amplitude, duration and frequency.
Author

N65-27606# Parametrics Inc., Waltham, Mass.
RADIOLOGICAL MECHANISMS FOR GEOPHYSICAL RESEARCH Annual Report, Oct. 31, 1963–Oct. 31, 1964
M. Bramson and C. A. Ziegler Washington, AEC, 31 Oct. 1964 27 p refs
(Contract AT(30-1)-2983)
(NYO-10221) CFSTI: $2.00

A prototype gauge for in-situ measurement of suspended sediment concentration in rivers and streams was designed, constructed and tested. The gauge consists of two major components: a measuring head, approximately 8" × 12" × 30", capable of being mounted underwater on a wall or supporting pier; and a shore based unit, 12" × 12" × 14", containing electronics and readout. The operation of the gauge is based on measuring the ratio of the attenuation of x-rays through the ambient water and through a reference cell containing distilled water. This ratio is a function of the ratios of the densities of the two liquids and therefore in the absence of an appreciable amount of dissolved material the ratio is a function of the concentration of suspended sediment in the ambient water. The x-rays are provided by a radioisotope source, Cd-109, whose position is rapidly switched mechanically to allow attenuation measurements to be alternately made on the reference cell and on ambient water. The radioisotope source strength is about 5 mc, and since most of the radiation emitted is in the form of easily shielded low energy x-rays no special handling is required. The gauge has been field tested and performance data is presented. Author

N65-27632# Lockheed Missiles and Space Co., Sunnyvale, Calif.

STRESS ANALYSIS OF BONDED JOINTS

L. R. Lunsford 19 Mar. 1965 44 p refs Presented at the Picatinny Arsenal Symp. on Structural Adhesives Bonding, Hoboken, N. J., 14–16 Sep. 1964 Submitted for Publication (LMSC-A735422; SSD-9500-65-2)

Theoretical expressions for the analysis of three types of bonded metal-to-metal joints together with verification data are presented. Also, the relative advantages of theoretical analysis over empirical methods are discussed. Theoretical analysis for designs of metal-to-metal joints was developed to replace empirical analysis, which is costly and time consuming involving the testing of components to prove the design. Theoretical analysis, with elastic elements, was derived for three types of basic joints. Designs of metal-to-metal joints were verified by the use of simple ultimate strength tests. The tests were performed on specimens with bonded joints fabricated with adhesives having an essentially constant shear modulus to failure. It was recommended that verification of the three analytical expressions be completed, and that adjustments required to consider inelastic strains be developed. R.W.H.

N65-27651# United Aircraft Corp., East Hartford, Conn. Research Labs.

EXPLORATORY INVESTIGATION OF GLASS-METAL COMPOSITE FIBER Final Report, Apr. 13, 1964–Apr. 12, 1965

John E. Cox, Richard D. Veltri, and Charles E. Shulze 7 May 1965 109 p refs

(Contract NOw-64-0389-f)

(D910242-6; AD-615098)

Studies were concerned with the development of a process for the production of continuous metal filaments by casting of molten metal as a core material in a glass capillary which was continuously formed from glass tubing. Beryllium and copper received major consideration as the core materials, but chromium, aluminum, iron, and tin were also considered. A few short lengths of beryllium-in-glass composite fiber have been obtained by the use of protection tubes in the continuous process, but the destructive reaction between beryllium and glass was not sufficiently reduced to permit longer lengths to form. A pressure technique for directing a fine stream of molten beryllium from a nozzle into the fiber-forming cone of glass was found to be the best approach for further investigations. Copper-glass composite studies have been concerned chiefly with specimen preparation and process variables such as size, type, and purity of raw materials, temperatures, furnace design, and forming rates. Copper core diameters in the range of 20 microns have been obtained in lengths up to 34 ft, but the core diameters in the submicron range have lacked continuity. M.W.R.

N65-27677*# National Aeronautics and Space Administration, Washington, D. C.

APPLICATION OF THE DIRECT READING EMISSION SPECTROMETER IN PROCESS CONTROL [HAKKO BUNKO BUNSEKI NO PROCESS E NO OYO]

Yoshimi Tachibana May 1965 22 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Tokyo), v. 67, no. 11, 1964 p 1744–1748

(NASA-TT-F-9343) CFSTI: HC $1.00/MF $0.50 CSCL 20F

Several modifications of the "Quantometer," "Quantograph," or grating polychromator (a type of direct reading emission spectrometer), are described and evaluated. Among these are an improved vacuum version that extends into the ultraviolet region, a miniaturized version with ultrahigh-precision grating, and a computer that operates in conjunction with one or more spectrometers to provide automatic process control of several elements simultaneously. Formulation of the calibration curve is discussed. Details of the operation, advantages, limitations, and prospects of these instruments in application to the nonferrous metal, light metal, steel, cast iron, and automotive industries are presented. The introduction of the computer results in higher analytical reliability, self-checking capabilities, speedier analysis, fewer operator personnel, and on-line data processing. Author

N65-27758# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering

RELIABILITY ANALYSIS OF NON-ELECTRONIC COMPONENTS USING WEIBULL, GAMMA, AND LOG NORMAL DISTRIBUTIONS

Dutton Gordon Stoy (M.S. Thesis) Aug. 1964 83 p refs

(GRE/MATH/64-12; AD-610774)

Reliability analysis using the Weibull, log normal, and gamma distributions for non-electronic components is complicated by non-standardization, small lot sizes, and the interaction between components. The Weibull distribution is useful in the failure analysis of structures, ball bearings, brittle beams, and spin gyros. The log normal distribution is used in the failure analysis of aircraft structures and helicopter blades, while the gamma distribution is useful in failure analysis of aluminum strips. Author

N65-27776# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering

RELIABILITY ANALYSIS OF A HIGH-SPEED, EXTRA HIGH-PRESSURE AIRCRAFT TIRE

Stanley O. Smith (M.S. Thesis) Aug. 1964 61 p refs

(GRE/MATH/64-11; AD-610772)

Failure distribution model and reliability function are derived for the B-58 tire. The model results in a combined chance failure (exponential) and wearout (normal) failure distribution. The method used is general and may be applied to any aircraft tire. The areas of contractual specification, inspection procedures, and reporting of failures are analyzed. An operating characteristic curve for the acceptance sampling plan is constructed, showing the plan offers little protection for the consumer. A plan from MIL-STD-414 is selected and recommended. Deficiencies are found to exist in the reliability demonstration method and the area of failure data collection. Author

N65-27786# Southwest Research Inst., San Antonio, Tex. Dept. of Aerospace Propulsion Research
FUNDAMENTAL INVESTIGATION OF LIQUID-METAL LUBRICATED JOURNAL BEARINGS Topical Report, Apr. 1, 1964-through Mar. 31, 1965
R. A. Burton, H. J. Carper, and Y. C. Hsu 16 Apr. 1965 110 p refs
(Contract AT(11-1)-1228)
(SwRI-1228-60)

A program is reported with the objective of providing basic information for liquid-metal lubricated bearings with emphasis on turbulence and film-inertia effects. The experiments make use of a large-scale bearing model, with 6-foot diameter and 0.5 in. film thickness. The working fluid is air, and Reynolds numbers comparable to those in liquid-metal lubricated bearings may be simulated. Data on velocity profiles, friction coefficients, and turbulence intensity are reported for concentric and eccentric operation. Data are also reported for extremely distorted flows produced by placing a blockage in the film. An analytical approach is reported, which exploits experimentally measured (or theoretically computed) profile parameters to predict pressures in bearing configurations. Data are given which show that inertial effects at the boundaries of the bearing film may at times be of primary importance in bearing calculations. Author

N65-27807# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
METALS JOINING Review of Recent Developments
R. M. Evans 11 Jun. 1965 4 p refs

Brief summaries of information are presented on refractory-metal joining, titanium, and nickel research which became available during the preceding months. Tabulated charts are given on (1) results of tensile tests on Ti-6Al-4V weldments; (2) effect of thermal exposure upon room-temperature tensile properties of welds in Ti-8Al-1Mo-1V; (3) properties of welds in Ti-8Al-1Mo-1V at elevated temperatures; and (4) mechanical properties of multiple-spot-welded specimens. A graph is presented on oxidation of 0.050-in. TD nickel in brazed tee joints. N.E.A.

N65-27829*# Dynamics Research Corp., Stoneham, Mass.
[PRECISION TORQUE MEASURING SYSTEM] Final Progress Report, 24 Jun. 1964-17 Mar. 1965
29 Mar. 1965 47 p With Operations Instructions Manual
(Contract NAS8-11724)
(NASA-CR-63730; R-52) CFSTI: HC $2.00/MF $0.50 CSCL 13I

The Precision Torque Measuring System is an electromechanical system used for measuring torques in the range of 0.1 to 50 000 dyne-cm where low threshold and high accuracy are required. The system consists of gas bearing with enclosure, and a console. The bearing supports the test specimen, and together with the electronics in the console constitute a torque feedback system. The console also contains a strip chart recorder, gas controls, and a vacuum pump. The system is divided into three functional groups: (1) gas bearing; (2) electronics; and (3) vacuum system. The physical description of the system and the theory of operation are presented. The theory of operation discusses the design approach of the several subsystems. System theory equations are derived along with the calibration procedure. Installation, operation, and maintenance of the system are discussed. N.E.A.

N65-27855# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME CHIEF RESULTS OF INVESTIGATIONS ON THE APPLICATION OF REINFORCED CONCRETE IN HEAVY MACHINE BUILDING AND PRESS CONSTRUCTION
I. G. Lyudkovskiy 20 Apr. 1965 46 p Transl. into ENGLISH of the book "Primeneniye Zhelezobetona v Mashinostroyenii, Izdatel'stvo" Moscow, 1964 p 3-42
(FTD-MT-65-55; AD-615853)

In the collection is described the experience of designing and manufacture of reinforced concrete beds of presses and stretch-straightener, basic parts of metal working machine tools and other machines; experimental investigations of main units of reinforced concrete machines, models of beds of full-scale samples; theoretical investigations and treatment of methods of calculation of complex massive components, reinforced concrete machines, and spiral chambers or reinforced concrete hydraulic turbines. Besides presentation of theoretical questions, the collection gives practical approximate methods and examples of calculation. Author

N65-27856# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHETIC OILS FOR TURBINE ENGINES
Boleslawa Mielnikowa 8 Dec. 1964 18 p refs Transl. into ENGLISH from Tech. Lotnicza (Poland), no. 2, 1963 p 37-42
(FTD-TT-64-117/1+2; AD-455605)

The requirement for better lubricants by high-speed aircraft is discussed and the synthetic lubricants used by various countries are briefly reviewed. Among the synthetic lubricants discussed are the esters of the mono and polybasic alcohols and organic dicarboxylic acids, esters of silicic acid and higher monobasic alcohols, and the silicones. It is observed that dicarboxylic acid esters are the most suitable lubricants for turbo engines. Data are given for commercial lubricants available for turbine engine and aviation lubrication. E.E.B.

N65-27881# Aeronautical Research Council (Gt. Brit.)
THE DESIGN AND DEVELOPMENT OF AN AIR-BEARING FOR THE MEASUREMENT OF DAMPING IN YAW ON A JET-BLOWING MODEL
A. P. Cox London, HMSO, 1965 22 p refs Supersedes RAE-TN-AERO-2958, ARC-26075; see X64-15750
(ARC-CP-796; RAE-TN-AERO-2958; ARC-26075) HMSO: 5s 6d

This Note describes the design and development of an air-bearing support assembly, for damped oscillation measurements of yaw damping derivatives on V./S.T.O.L. blowing models, commencing with a jet-flap model. The bearing, fitted within the fuselage, allowed freedom in yaw, but supported all the other forces and moments. Typically, with a bearing air supply of 0.07 lb/sec at 60 p.s.i.g., a vertical load of 400 lb could be sustained, or a pitching-moment of 650 lb in. with the vertical load reduced to 150 lb. From measurements of the overall rig damping rate, the internal damping of the bearing was determined by allowing for the contributions from spring hysteresis loss and external aerodynamic loads. The internal damping of the bearing, which was unaffected by the transmission of the simulated wing airflow (amounting to 2 lb/sec at 15 p.s.i.g.), was found to be negligible as long as the bearing capacity was not exceeded. Author

N65-27890# Aerojet-General Corp., Sacramento, Calif.
HYDROSTATIC BEARING FEASIBILITY PROGRAM Second Quarterly Progress Report, 1 Oct.-31 Dec. 1964
25 Jan. 1965 20 p
(Contract AF 04(611)-7439)
(Rept.-7439-Q-2; AD-610493)

Developments in a feasibility study of liquid lubricated hydrostatic journal and thrust bearings for large liquid rocket engine turbopumps are reported. Computer programs were extended to include the calculation of friction factors on bearing

sill, Reynolds number of flow across sill, bearing friction torque, heat generation rate, and temperature change of fluid passing through the bearing. The turbulent flow hydrostatic journal bearing computer program was used to determine the optimum pressure ratio at the no-load condition for a given set of design conditions. At high eccentricity ratios, the maximum load capacity occurs for pressure ratios in the range 0.3 to 0.4 for the particular bearing geometry selected. The variable speed electric drive equipment was assembled. The tester was alined to the electric drive output shaft with a degree of tolerance less than that used as a design basis for the high speed coupling. Two test bearings were instrumented with pressure transducers, thermocouples, and Bently distance detectors. The oil and water test bearing lubricating systems were installed. R.N.A.

N65-27926# Houghton (E. F.) and Co., Philadelphia, Pa.
DEVELOPMENT OF FIRE RESISTANT WATER BASED HYDRAULIC FLUIDS Bimonthly Report
Philip Rakoff, G. John Colucci, and Robert K. Smith 27 Jan. 1965 18 p
(Contract NObs-90269)
(BMR-5; AD-610379)

Improving the corrosion properties of fire resistant, water based hydraulic fluid, a series of hydroxy alkylene carboxylates have been prepared as potential corrosion inhibitors. In addition, a continuing study has been made of the correlation existing between corrosion of control panels in hydraulic systems and bench corrosion tests. Several aromatic ether derivatives are concurrently being evaluated as autoignition improvers. An attempt has also been made to alter the structure of the glycol portion of fluid so that a higher autoignition temperature is attained in the finished formula. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-26678 Varian Associates, Beverly, Mass.
TIME AND FREQUENCY COMPARISONS WITH THE ATOMIC HYDROGEN MASER
H. E. Peters, J. Vanier, and R. F. C. Vessot *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 297–304 refs Sponsored by ONR (See N65-26657 16-14)

The fractional relative stability data taken over several months have shown the masers to be stable to well within 2×10^{-12}. R.M.S. values taken over intervals of hours and tens of seconds give fractional relative stability figures of 4.8×10^{-13} and 8.7×10^{-14}, respectively. Drift effects of the order of 1×10^{-12} are due to thermal effects of the cavity resonator. Short term statistical fluctuations are predictable from the noise characteristics of the receiver. Cavity tuning by means of the spin exchange relaxation processes completely cancel, in the oscillating maser, the effect of pressure shift in frequency. Maser frequency resettability using this method has been found to be better than 5×10^{-13}. Improvements in maser design resulting in longer lifetime and smaller size have resulted in the construction of a production prototype occupying 4 square feet of floor space and 6 feet in height. Lifetime, limited by the pumps, should be well in excess of two years. Details of improvements in thermal control circuitry are described. Measurements of time comparison on the masers via Loran "C" are outlined. Author

N65-26679 Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
ON THE FOCUSSING OF ATOMIC BEAMS FOR HYDROGEN MASERS [ZUR FOKUSSIERUNG VON WASSERSTOFFATOMSTRAHLEN FUR WASSERSTOFFMASER]
Gerhard Becker and Bernd Fischer *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 305–316 refs In GERMAN; FRENCH and ENGLISH summaries (See N65-26657 16-14)

The distribution of the density of the beam at the site of the detector has been calculated under the assumption of a point source of hydrogen atoms and of a relatively short magnetic deflection system (which can be idealized like in the optical case by a thin lens). It is taken account also of the velocity distribution of the atoms in the beam. The results are represented by approximation formulas. They suggest certain design principles for optimising the separation of the states in the deflection system. Moreover the possibility to use annular magnetic fields instead of six-pole fields for the separation and focusing has been analysed. Author

N65-26684 Czechoslovak Academy of Sciences, Prague.
RESULTS OF EXPERIMENT WITH 2 AMMONIA MASERS [VERSUCHSRESULTATE MIT ZWEI AMMONIAKMASERN]
Uiktor Trkal *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 365–373 refs In GERMAN; ENGLISH and FRENCH summaries (See N65-26657 16-14)

This paper discusses the methods of tuning the cavity by modulation of the ammonia pressure and by Zeeman modulation. The influence of the design parameters of the apparatus will also be discussed. Author

N65-26685 Besancon Univ. (France). Laboratoire de l'Horloge Atomique.
THE USE OF THE ZEEMAN EFFECT ON THE 3.3-LINE OF $N^{14}H_3$ [APPLICATION DE L'EFFET ZEEMAN A LA RAIE 3-3 DE $N^{14}H_3$]
M. Olivier *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 375–382 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

Zeeman modulation of an ammonia Maser used as a frequency standard gives a criterion for setting the frequency of the cavity. The hyperfine structure of the 3.3-line gives a complex dependence of the frequency of oscillation on the magnetic field. We have studied this effect proving that nevertheless the Zeeman effect can be used as a tuning criterion for a secondary frequency standard. A precision of 10^{-11} is achieved for the measurements and the stability of the frequency depends only on the resettability of the experimental parameters. Author

N65-26766 Naval Ordnance Lab., Corona, Calif. Electricity and Magnetism Div.
OBSERVATION OF MAGNETIC DOMAINS BY MEANS OF HeNe LASER LIGHT
J. L. Tomlinson *In its* Foundational Res. Proj. 1 Mar. 1965 p 1–3 refs (See N65-26765 16-26)

A helium-neon gas laser was used as the light source to study the Kerr magneto-optical effect of a ferromagnetic thin film consisting of 80% Ni and 20% Fe. The magnetic-optic effect could be seen through a microscope as a red spot when the film was magnetized in the direction of maximum intensity of the magneto-optic image. Rotation of a permanent magnet near the film changed the direction of the magnetization and caused the red spot to disappear. Attempts to observe a change in intensity with a photomultiplier were not successful. G.G.

N65-26769 Naval Ordnance Lab., Corona, Calif. Electricity and Magnetism Div.
PARTIALLY COHERENT LIGHT FROM INCOHERENT SOURCES
T. Hadeishi *In its* Foundational Res. Proj. 1 Mar. 1965 p 45–51 refs (See N65-26765 16-26)

The mechanism which makes it possible for a low-pressure mercury vapor tube with suitable filters to produce light of a greater linear coherence than the light from a ruby laser is discussed. The theory is first presented classically for a simple case, and then based on the quantum field theory. G.G.

N65-26930 Hoffman Electronics Corp., Santa Barbara, Calif. Science Center.
DIRECT CURRENT STIMULATED ELECTROLUMINESCENCE Final Report
30 Oct. 1964 12 p
(Contract N123(62738)35519A(X))
(AD-461889)

Recombination in p–n junctions in gallium arsenide diodes was studied to develop injection luminescent radiation sources with desirable operating characteristics. Work was done on improving the internal quantum efficiency of spontaneous radiation in the diode, in the belief that a reduction in the percentage of nonradiative recombinations at room temperature may be possible. Junctions were fabricated using diffusion of zinc into n-type gallium arsenide, and by epitaxial growth from gallium and tin melts. The melts were doped by the addition of small amounts of metallic zinc, tellurium, or selenium. Laser threshold current versus temperature were plotted for both the diffused junctions and the solution grown junctions. It appears that the probability of spontaneous radiative recombination is greater in the solution grown epitaxial diodes, especially at higher temperatures. In another experiment, measurements on diodes from over 50 junctions grown epitaxially from solution in either gallium or tin indicate that donors in the crystal, from column V of the periodic chart, are about equally effective in producing radiative recombination. This is compared to silicon in which, at concentrations of up to about 10^{17} cm^{-3}, the radiative recombination efficiency is about the same as column V donors, but increases by a factor of three at higher concentrations. L.S.

N65-27084# Barkley and Dexter Labs., Inc., Fitchburg, Mass.
RESEARCH TOWARD DEVELOPMENT OF GEOMETRIC DISTANCE AND ANGLE MEASUREMENT SYSTEMS Final Report
Raymond B. Wilson, Jr. Jan. 1965 102 p refs
(Contract AF 19(628)-3895)
(AFCRL-65-196; AD-615912)

This report documents work done under Contract AF19-(628)-3895 and includes gas laser, ruby laser, shutter timing and photomultiplier tube studies and investigations. The two areas reported on in laser work are a feasibility study of a gas laser in geodetic leveling, which terminates in suggestions for a gas laser oriented leveling system, and a medium power Q-switched laser capable of ranging experiments. The Q-switched laser was constructed under the contract. Research support was given to AFCRL in the shutter and photomultiplier tube studies. A portable laser power supply, timing system for a PC 1000 external shutter, and 5 channel current amplifier were constructed under this contract, and a description of each is given. Author

N65-27088# Technical Research Group, Inc., Melville, N. Y.
THEORETICAL RESEARCH ON LASER OSCILLATION Final Report
Morris C. Newstein, Stephen R. Barone, and Nicholas Solimene Bedford, Mass., AFCRL, May 1965 21 p refs
(Contract AF 19(604)-8817)
(AFCRL-65-270; AD-615804)

Topics considered in six scientific reports prepared under the contract are: the theory of plane-parallel Fabry-Perot resonators, perturbed Fabry-Perot resonators, Fabry-Perot resonators at small Fresnel numbers, thermal fields and spontaneous emission in open resonators and the quantum theory of optical coherence. Abstracts and summaries of these six reports are presented as well as an account of some preliminary results on a dynamical theory of laser oscillation. Author

N65-27203# International Business Machines Corp., Yorktown Heights, N. Y. Thomas J. Watson Research Center
INJECTION LASER STUDY Seventh Quarterly Progress Report, 1 Dec. 1964–28 Feb. 1965
K. Konnerth, F. F. Morehead, F. Stern, P. R. Wagner, and K. Weiser [1965] 104 p refs
(Contract DA-36-039-AMC-02349(E))
(Rept.-7; AD-615147)

Switching characteristics of P–P°–N negative resistance diodes are determined. The breakdown voltage and the sustaining voltage of the devices are in good agreement with theory, but the switching times are somewhat longer than predicted by theory. Numerical procedures for solving the complex eigenvalue equation are described in detail. A method for finding the number of square integrable solutions with continuous derivatives which fall in any region of the complex eigenvalue plane is also described. The procedures found solutions that were overlooked previously. A numerical example is given. The emission of yellow electroluminescence at 77° K, by electron injection from an indium contact into an insulating region on the surface of phosphorus-doped ZnTe, was observed in a 30-micron-thick layer adjacent to the contact. The emission had a quantum efficiency of 10^{-4}. No visible emission was obtained at room temperature. A simple theory of the response of semiconductor absorbers and amplifiers to high intensity monochromatic light is in qualitative agreement with experiment. L.S.

N65-27234 Joint Publications Research Service, Washington, D. C.
STATISTICAL CHARACTERISTICS OF THE AUTOMODULATION OF THE SOLID LASER RADIATION
V. I. Bespalov and A. V. Gaponov *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 85–99 refs (See N65-27225 16-34) CFSTI: $6.00

The influence of spontaneous radiation on the behavior of a two-level system with different longitudinal and transverse relaxation times located within a one-mode resonator was studied. Results show that spontaneous radiation leads to a more rapid attenuation of modulation during the transient regime. Maximum power was found in the peaks of solid laser radiation, the magnitude of which was logarithmically dependent on the intensity of spontaneous radiation. Included is an analysis of equations used to establish laser oscillations without allowing for fluctuations, laser oscillations in the presence of spontaneous radiation, the distribution function of radiation intensity within the maximum of the first peak, and the influence of spontaneous radiation on the characteristics of consecutive peaks. S.C.W.

N65-27236 Joint Publications Research Service, Washington, D. C.
STEADY-STATE OSCILLATIONS OF LASERS WITH DISTRIBUTED LOSSES

L. A. Ostrovskiy and Ye. I. Yakubovich *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 114–123 refs (See N65-27225 16-34) CFSTI: $6.00

Electromagnetic oscillations within a plane parallel layer containing two-level active molecules, where the axis-x is perpendicular to the boundaries of the layer, were studied. Energy losses stimulated by radiation across the layer's boundaries, and losses within the medium containing active molecules, are considered in the analysis. The frequency spectrum of steady-state nonlinear oscillations and the corresponding spatial distributions of amplitudes and phases were determined. It is shown that the presence of volume losses within thick layers leads to nonunique space distribution of the fields of a given frequency. S.C.W.

N65-27252 Joint Publications Research Service, Washington, D. C.

OBSERVATION OF MULTIBEAM GENERATION OF A HELIUM-NEON LASER

Yu. I. Zaytsev and D. P. Stepanov *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 265–268 refs (See N65-27225 16-34) CFSTI: $6.00

Reported are results of several experiments with a helium-neon laser in which multibeam radiation with a wave length of 0.6328 microns was observed. Excitation was achieved by introducing into the resonator a laser generating heterogeneities either in the form of a flat plate with a wedge of optical or quartz glass at the Brewster angle to the beam of radiation, or opaque objects, as a segment of wire, perpendicular to the axis of the beam. Observed were single oscillational processes, partial oscillations, and four- and three-beam oscillations. The conditions of multibeam generation were stable with respect to dimensional changes of the resonator. Data are included on the wobbling of adjacent modes in straight beams and of corresponding modes in the radiation angular-type oscillations. S.C.W.

N65-27253 Joint Publications Research Service, Washington, D. C.

THE PARAMETER OF EXCITATION OF A BEAM-TYPE MASER

A. F. Krupnov and V. A. Skvortsov *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 269–274 refs (See N65-27225 16-34) CFSTI: $6.00

Presented are results of an attempt to estimate the value of the maximum permissible parameter of excitation of beam-type maser generators, which focuses on determining quantitatively the influence of collisions in the beam. Examined is a parallel molecular flux impinging on a sorting system having optimum length and radius, in which half of the molecules are on upper levels and half are on lower levels. The dependence of the parameter of excitation on the size of the molecular flux and the length of the sorting system was determined. Results obtained are compared with data from an experiment with a formaldehyde molecular generator. S.C.W.

N65-27581# Hughes Aircraft Co., Culver City, Calif. Laser Development Dept.

CONTINUOUSLY PULSED LASER DEVICE FOR SURVEILLANCE Second Quarterly Report, 1 Oct.–31 Dec. 1964

James H. Morse [1964] 19 p

(Contract DA-28-043-AMC-00326(E))

(Rept.-2; AD-614445)

This report describes experimental Nd:YAG laser heads using both tungsten lamps and xenon flashtubes for pump excitation. These preliminary experiments were directed to gain information for designing high repetition rate, Q switched laser. Final design of the device is being delayed pending the receipt of suitable Nd:YAG crystal. Author

N65-27655# RAND Corp., Santa Monica, Calif.

QUANTUM STATISTICAL DYNAMICS OF LASER AMPLIFIERS

Dennis Holliday and A. E. Glassgold (New York Univ.) Apr. 1965 74 p refs

(Contract AF 49(638)-700; Proj. RAND)

(RM-4516-PR; AD-615026)

A quantum statistical procedure for studying interacting radiation fields is developed and applied to a model laser operating as a linear amplifier. The method utilizes an expansion of the density matrix in terms of a complete set of orthogonal operators originally used by Weyl. One mode of the laser field is considered to interact with a pumping mechanism and with a loss mechanism. A general solution for the density matrix is obtained and then applied to various initial conditions. It is found that a classical statistical interpretation of the results is frequently appropriate. Author

N65-27885# Linde Div., Union Carbide Corp., Indianapolis, Ind.

CZOCHRALSKI RUBY Semiannual Technical Summary Report, 1 May–31 Dec. 1964

M. N. Plooster, H. M. Dess, and O. H. Nestor 22 Jan. 1965 41 p refs

(Contract Nonr-4132(00); ARPA Order 306-62)

(SCR-65-1; AD-610600)

The quality of Czochralski ruby was significantly improved during the report period. The gain resulted from closer controls on growth parameters, ambient atmosphere, and melt temperature. Crystals grown under preferred conditions are bubble-free and of high optical quality. Optical paths through 6-mm-diameter × 4–5cm-long × .03–.04 wt percent Cr_2O_3 60° orientation rubies are uniform over the rod aperture to within a wavelength (Cdl 6438A) or better. The passive beam divergence observed approaches the diffraction limit. 90° and 0° rubies grown on Verneuil seed rods are of lesser quality in that order. A rough estimate based on rocking-curve data indicates an 8-second upper limit on mosaic structure in current ruby. The remaining optical inhomogeneity is due principally to chromium variations and probably residual stress. Author

N65-27889# United Aircraft Corp., East Hartford, Conn United Aircraft Research Labs.

INVESTIGATION OF THE MECHANISMS ASSOCIATED WITH GAS BREAKDOWN UNDER INTENSE OPTICAL ILLUMINATION Semiannual Report, 31 Aug.–31 Dec. 1964

Alan F. Haught 26 Jan. 1965 15p

(Contract Nonr-4696(00); ARPA Order 306)

(C-920272; AD-610565)

Investigation continued on the physical mechanisms involved in the electrical breakdown of gases under intense optical illumination. Studies of gas breakdown by optical frequency radiation were conducted in argon and helium over the pressure range from atmospheric pressure to 500 psi using the .69 and 1.06 micron radiation from high intensity ruby and neodymium lasers. The breakdown threshold electric field decreases with pressure for both lasers. The attenuation of the irradiating neodymium laser beam was measured by the breakdown plasma produced. One-half of the incident laser energy can be absorbed by the breakdown plasma and the incident beam can exceed 90% during the latter portions of the giant pulse. Attenuation of a helium-neon laser beam was measured by breakdown plasma and attenuations of 80% to 90% were observed for times up to several milliseconds following the incident laser pulse. Diffusion loss effects on the breakdown threshold were measured by varying the volume within which the breakdown is produced. The breakdown threshold is inversely related to the focus volume diensions. R.N.A.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-26725 Société Suisse de Chronometrie, Neuchâtel.
RADIOCRISTALLOGRAPHIC STUDY OF COPPERBERYLLIUM ALLOYS [ETUDE RADIOCRISTALLOGRAPHIQUE DES ALLIAGES CURIVRE-BERILLIUM]
Lucien Chollet *In its* Intern. Conf. on Chronometry, Vol. 2 [1964] p 881–890 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The technical copper-beryllium alloys contain some other metals in low concentrations, such as impurities or additional elements. These additions strongly affect the shape of the hardness curves. In this paper, the modifications of the equilibrium diagrams due to some impurities are studied. The investigations are carried out with a high temperature diffraction camera. This technique avoids structural modifications during quenching. Three-phase-domains are revealed, confirming the "pseudo-ternary" character of these alloys. The hardness development of some alloys is studied by x-ray diffraction. Author

N65-26730 Société Suisse de Chronometrie, Neuchâtel.
ON THE INTERPRETATION OF MECHANICAL PROPERTIES OF RAW MATERIALS USED IN THE WATCH INDUSTRY [SUR L'ETUDE DES PROPRIETES MECANIQUES DES MATERIAUX HORLOGERS, PAR L'INTERPRETATION D'UNE COURBE D'ESSAIS]
Pierre Vernotte *In its* Intern. Conf. on Chronometry, Vol. 2 [1964] p 953–960 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

An experimental curve may be fitted by a formula containing several parameters; these parameters vary during the working of the material. The method of using a formula becomes unreliable when too many parameters are involved. In this case, a simple formula has to be used which takes account of the experimental curve and contains only the 2 or 3 most important parameters. The present case deals with stretching curves in which the derivative of the force with respect to the stretch x can be represented by $A[1 - \exp(-B/x^n)]$; such a curve can be approximated by 2 straight segments in such a way that the parameters A, B, n are easily determined. The author then studies the influence of the working, especially the structural hardening of Elinvar (experiment by Langue) as a function of the temperature of the recovery. Author

N65-26731 Societe Metallurgique, d'Imphy (France). Centre de Recherches.
RECENT INVESTIGATIONS OF HARDENING OF HIGH TENSILE ALLOYS OF INTEREST IN THE WATCHMAKING INDUSTRY [RECHERCHES RECENTES SUR LE DURCISSEMENT D'ALLIAGES A HAUTE LIMITE ELASTIQUE INTERESSANT LA CHRONOMETRIE]
P. Legendre, J. L. Castagné, Palmier-Gerber, and X. Waché *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 961–974 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

Physical and thermal experiments, completed by measurements of certain physical properties as resistivity, thermoelectric power, saturating induction, magnetostriction, plasticity at different temperatures, can be used to explain the phenomena which accompany the hardening of high tensile alloys. More specifically in certain nickel-steels with structure hardening in martensitic phase, the technique of the dilatometric and thermomagnetic isothermal recovery had made it possible to observe during the recovery after quenching, the formation of an austenitic ferromagnetic phase of which the effects on the machinability and deformability in the plastic region have been studied. Furthermore, the coexistence of 2 phases, one martensitic, the other austenitic and ferromagnetic, makes it possible to obtain by a suitable choice of the composition and relative concentration of the two phases a very low global thermoelastic coefficient associated with a high elastic limit over 200 kg/mm^2. The same experimental technique has already been applied to study the mechanism of hardening of austenitic cobalt-steels in which disorder-order transformations had been observed. Author

N65-26732 Centre Technique de l'Industrie Horlogere, Besancon (France). Service Métallurgie.
THE EFFECT OF THE MICROGRAPHIC STRUCTURE ON THE MACHINABILITY OF BRASSES WITH 39% OF Zn AND 2% OF Pb [INFLUENCE DE LA STRUCTURE MICROGRAPHIQUE SUR L'USINABILITE DES LAITONS A 39% DE Zn ET 2% DE Pb]
Michel Massin *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 975–989 In FRENCH; ENGLISH and GERMAN summaries (See N65-26708 16-14)

The machinability of brass is often considered by the watch industry and by the micromechanics as the aptitude to leave no burr after machining. This particular aspect is related directly to the dimensions of the chips. Experiments have shown that the fineness of the distribution of the two alloy components α and β' have an influence on these two phenomena. Systematic experiments effected at an industrial scale with brasses which were especially but industrially prepared have shown the practical benefit which be drawn from the knowledge of the phenomena mentioned above. Author

N65-26734 Sanovikens Jernwerks, A. B. (Sweden).
FREE MACHINING STEELS AND SPRING MATERIALS USED IN THE WATCH INDUSTRY [DECOLLETAGESTAHL UND FEDERWERKSTOFFE FUER DIE UHRENFABRIKATIONBEURTEILUNG OPTIMALER EIGENSCHAFTEN]
Axel Bernstein *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 2 [1964] p 1001–1020 refs In GERMAN; ENGLISH and FRENCH summaries (See N65-26708 16-14)

Machinability tests made on a number of steels with different compositions such as a free machining iron for case-hardening, direct hardenable steels with moderately high and high carbon contents and one stainless steel will be presented. The tests have been made under conditions similar to actual manufacturing conditions for watch parts of high precision. The most suitable structure of the steels with respect to machinability, heat treatment and function of the parts is discussed. An evaluation is made of the various steels with respect to the method of machining and the tools used. The advantages and shortcomings of an alloyed steel for such parts is discussed with regard to heat treatment, ductility and machinability. For main springs in watches many different materials are now used such as carbon steel, stainless steel and various alloys. The essential properties for a good main spring are reviewed and the possibility to meet the requirements with the available spring materials. Improvements of the properties in stainless steel springs in recent years are presented. Results of extensive comparative tests between springs made of stainless steel and alloys are

given. Finally, the question whether the magnetic properties of the spring materials affect the spring properties, is discussed. Author

N65-26764# Battelle-Northwest, Richland, Wash. Reactor and Materials Technology Dept.
THE STEADY-STATE CREEP OF HIGH-PURITY PLUTONIUM
R. D. Nelson, T. K. Bierlein, and F. E. Bowman Jan. 1965 20 p refs
(Contract AT(45-1)-1830)
(BNWL-32)

This report presents results of steady-state, compressive creep experiments on the six allotropes of plutonium. These results are discussed and correlated with similar information about more common metals. Steady-state creep data were needed for the analysis of transformation creep data which provided information on the type of mechanism that might be responsible for these transformations. Author

N65-26926# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.
THE EFFECT OF DEFORMATION AND HEAT TREATMENT ON THE MECHANICAL PROPERTIES OF THE Ti–6Al–6V–2Sn–4Zr–1Fe–1Cu ALLOY
Perry R. Smoot Mar. 1965 20 p ref
(AMRA-TR-65-04; AD-615024)

The effect of deformation and heat treatment variables on the mechanical properties of a promising experimental alloy, Ti-6Al-6V-2Sn-4Zr-1Fe-1Cu, was determined utilizing material from a commercially procured ingot. Forging, solution, and aging temperatures and aging times were varied and the resultant notched and unnotched tensile and impact properties were obtained to establish the highest yield strength obtainable in combination with adequate ductility, as defined by Specification MIL-T-46038. This optimum combination of properties was obtained at a yield strength level of 200 ksi, with an elongation of 9 percent, a reduction of area of 26 percent, and Charpy V-notch impact energy of 6 foot-pounds at −40 F. Author

N65-26937# General Telephone and Electronics Labs., Inc., Bayside, N. Y.
IDENTIFICATION OF MICROSTRUCTURAL CONSTITUENTS AND CHEMICAL CONCENTRATION PROFILES IN COATED REFRACTORY METAL SYSTEMS Quarterly Report No. 1
D. J. Bracco, L. Sama, and P. Lublin 15 Oct. 1964 39 p refs
(Contract AF 33(615)-1685)
(TR-64-713.3; AD-461994)

The General Telephone & Electronics Laboratories are investigating microstructure and chemical concentration profiles in a survey of existing coated refractory metals systems, both as-coated and under high-temperature oxidizing conditions. The investigation employs a variety of techniques to obtain phase identification and composition data within each system. This report includes the first results of electron-probe surveys of the Cb-Si system after environmental exposure. These and succeeding results of the analyses will be evaluated to give a dynamic picture of coating behavior under high-temperature oxidizing conditions. Author

N65-26939# Dayton Univ., Ohio. Research Inst.
THE EVALUATION OF HIGH-TEMPERATURE MATERIALS Quarterly Progress Report, 1 Apr.–30 Jun. 1964
John C. Wurst, John A. Cherry, Dennis A. Gerdeman, and Norman L. Hecht 10 Jul. 1964 103 p refs
(Contract AF 33(615)-1312)
(QPR-2; AD-460905)

Progress is reported on the metallographic analyses, bend transition temperature measurements, tensile strength, and cyclic oxidation tests in the range of 3000° F; and the creep-rupture tests for C129Y and D43 columbium alloys. Photomicrographs and metallographic data are presented. Six coatings of C129Y columbium exhibited void-free substrate coverage. In each instance, there was some reduction in substrate thickness after coating ranging from 1/2-mil to 1-mil side reduction. Also, substrate recrystallization was observed in five of the six coatings tested. With D43 columbium alloy loss of substrate thickness after coating ranged from 0.82 to 0.62 mils/side. Detail data are given for the tests and analyses of the two columbium alloys with coatings from different sources. E.E.B.

N65-26945# Du Pont de Nemours (E. I.) and Co., Baltimore, Md.
COLUMBIUM "H" SECTION PROGRAM. PHASE I: EXTRUSION. PHASE II: DRAWING Interim Report II, 1 Oct. 1963–1 Jan. 1964
E. V. Peterson Wright-Patterson AFB, Ohio, AF Mater. Lab. [1964] 33 p ref
(Contract AF 33(657)-11293)
(Rept.-8-110(II); AD-429144)

The development of the extrusion process for D-43 (Cb-10W-1Zr-0.1C) and Cb-752 (Cb-10W2.5Zr) "H" sections continued. Efforts were concentrated on reduction of contamination and improvement of surface finish and dimensional control of extruded sections. Group II "H" extrusions (0.125" to 0.060" section thickness) showed reduced contamination and improved straightness, but surfaces and uniformity of section thickness were unsatisfactory. The results are reported and the future program discussed. Group I extrusions were drawn from section thickness of 0.188" at room temperature with reductions of 5% to 18% per pass. Total reductions up to 28% were made on short lengths without intermediate annealing. The results and future program are discussed. Author

N65-26962# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
TITANIUM AND TITANIUM ALLOYS
R. A. Wood 25 Jun. 1965 3 p refs

Recent developments in titanium and titanium alloys are reviewed. Among the developments reported were data pertinent to materials for use as surgical implants and prosthetic devices. Tensile properties, density, yield strength, corrosion in horse serum exposure, and anodic back-electromotive force are given for unalloyed titanium (annealed), Ti-6Al-4V alloy, tantalum (annealed), cobalt-base alloys, type 316 stainless steel, nickel, silver, and zinc. The tabulated data show the advantages of titanium and its alloys which might be realized when used in implants and prosthetic devices. Also, the effects of deformation and heat treatment variables were determined using a commercial titanium alloy Ti-6Al-6V-2Sn-4Zn-1Fe-1Cu ingot of 1100 lbs. The best combination of properties was obtained after forging at 1550° F, followed by solution treatment for one hour at 1550° F, and aging for two hours at 1050° F. The properties obtained are compared with those obtained on a smaller ingot of the basic composition Ti-6Al-6V-2Sn. E.E.B.

N65-26977 Joint Publications Research Service, Washington, D. C.
IMPROVING THE MACROSTRUCTURE OF ELECTROSLAG STEELS

Yu. I. Zabaluyev et al *In its* Studies in Electroslag Processes 21 Jun. 1965 p 5–10 refs Transl. into ENGLISH from Metallurgicheskaya i Gornorudnaya Prom. (Kiev), no. 2, Mar.–Apr. 1965 p 24–26 (See N65-26975 16-15) CFSTI: $1.00

Sectors of a crystallization layer were observed in the macrostructure of ball-bearing and structural steels which had been melted down by the electroslag remelting technique. An examination with different fluxes for the process revealed that it was possible to reduce the fluctuations of the thermal conditions of melting and the crystallization. Also, the change in flux did not give an inferior quality steel and the specific electric power consumption was reduced. Data are presented for the evaluation. E.E.B.

N65-26996# Aeronautical Research Labs., Melbourne (Australia).
METALLOGRAPHY OF CHROMIUM AND CHROMIUM ALLOYS
N. E. Ryan Nov. 1964 15 p refs
(ARL/MET-22)

The preparation of chromium and its alloys for optical and electron microscopic examination is described together with methods used for the isolation and identification of minor constituents in chromium alloys. Author

N65-27001 Army Materiel Command, Washington, D. C. Materials Section.
MATERIALS REQUIREMENTS AND APPLICATIONS IN THE ARMY
Peter R. Kosting *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 2 p (See N65-27000 16-34)

In this presentation, the Army's need for all categories of materials such as ceramics, metals, organic materials and composites is discussed. Studies continue on all weapon systems in order that potential changes in needs and uses of material may be forseen. By means of the merit rating of a material, partial, but simple, information about the ballistic performance can be exchanged easily. Work with aluminum over several years is reviewed to show the benefits gained by general research followed by application. N.E.A.

N65-27003 Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
CURRENT PROBLEMS IN FERROUS METALLURGY
George W. Roust and Howard W. Zoeller *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 23 p (See N65-27000 16-34)

A discussion of ferrous metallurgy problems with consideration of the trend in strength requirements which have been imposed upon ferrous alloys is presented. Basic factors pertinent to the use of high strength steels are considered. The difficulties in reducing these understood basic theoretical factors pertinent to the use of high strength steels to consistant engineering practice are discussed. Engineering controls necessary for continued improvement of steel technology are mentioned. N.E.A.

N65-27004 Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
LIGHT METALS
C. Bradley Ward *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 6 p (See N65-27000 16-34)

Some of the present application of nonferrous metals in the Air Force systems and problem areas associated with these applications are discussed. Metals considered are aluminum, magnesium, titanium, superalloys, and refractory materials. N.E.A.

N65-27005 Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Applications Div.
A REVIEW OF HIGH TEMPERATURE NONFERROUS METALS TECHNOLOGY
Darrell R. James *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 20 p (See N65-27000 16-34)

Aspects of refractory metal and superalloys capabilities and applications are discussed. The classes of materials which are available for structural use in various temperature ranges are shown. The superalloys find use up to approximately 2000° F, and the various refractory alloys are useful to temperatures far in excess of 4000° F. Examples are given of the combined success of utilizing both superalloys and refractory alloys for typical Air Force systems. N.E.A.

N65-27006 Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
AIR FORCE INTERESTS IN CERAMICS
John D. Latva *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 20 p refs (See N65-27000 16-34)

Some of the specific and identifiable problems associated with the uses of ceramics are discussed. The possible uses of ceramics are discussed with emphasis on the particular critical Air Force need for materials capable of maintaining functional integrity in high temperature oxidizing environments. Some of the successfully used ceramic systems are briefly mentioned. The Air Force approach to support research in ceramic technology to broaden its application is discussed. N.E.A.

N65-27008 Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
POWDER METALLURGY
George W. Trickett *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 6 p (See N65-27000 16-34)

This discussion is concerned with problems in the use of powder metallurgy processes and techniques for making aerospace vehicle parts and includes Air Force programs oriented towards the solution of some of these problems. Dispersion hardened alloys and fiber metallurgy parts are included in the discussion since they are now primarily made by powder metallurgy processes. N.E.A.

N65-27011 Aluminum Co. of America, New Kensington, Pa. Research Labs.
STATE OF THE ART ON NONFERROUS METALS
Walter A. Dean *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 32 p (See N65-27000 16-34)

Some of the unusual properties of the nonferrous metals and service applications where these metals are being used to advantage are pointed out. The light metals, in order of increasing melting point, Mg, Al, Be, and Ti are considered first. The heavy metals, also in order of increasing melting point, Pb, Zn, Cu, Ni, and refractory metal are discussed second. N.E.A.

N65-27013 Clevite Corp., Cleveland, Ohio.
POWDER METALLURGY. A REVIEW

Arthur D. Schwope *In* Am. Ordnance Assoc. Mater. Performance FPR Defense and Space Programs 19 Nov. 1964 5 p (See N65-27000 16-34)

Powder metallurgy is described as a method of bringing into close proximity large numbers of metal particles and subsequently applying heat to metallurgically bond these particles into a coherent structure. The particles may be all one material or may be a mixture of materials. Some examples of properties attainable by the powder metal route are given. The state of the art of the various elements of powder metallurgy is discussed. Some of the methods of bringing particles into close proximity so that subsequent heating can establish metallurgical bonds are described and some of the newer developments in sintering are discussed. N.E.A.

N65-27014 Corning Glass Works, N. Y. Ceramics Section.
A STATUS REPORT ON CERAMIC TECHNOLOGY
Marvin G. Britton *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 18 p (See N65-27000 16-34)

A discussion of recent significant trends in the ceramic industry is presented. Specific classes of ceramics discussed are: (1) refractories; (2) electronics; (3) coatings for metals; (4) cermets; (5) composites; (6) graphite; and (7) glass. N.E.A.

N65-27019# Atomics International, Canoga Park, Calif.
SOME HIGH TEMPERATURE MECHANICAL PROPERTIES OF ZIRCALOY-2, TYPE 304 STAINLESS STEEL, AND AM-350 STAINLESS STEEL
D. H. Stone 15 Jun. 1965 28 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11047) CFSTI: $2.00

This report presents the results of elevated temperature strength investigations of three alloys intended for high temperature application as nuclear reactor components. Zircaloy-2, Type 304 and AM-350 stainless steels are the alloys of interest. Creep rates and the creep activation energy of Zircaloy-2 were determined at 1200 and 1300° F. A correlation between carbon, nitrogen, phosphorous, and sulphur and the stress-rupture strength was found for Type 304 stainless steel. No effects of overaging were seen in AM-350 stainless steel in either tensile or creep tests near the aging temperature. Author

N65-27026# Joint Publications Research Service, Washington, D. C.
SCIENTIFIC FOUNDATIONS FOR DEVELOPING HIGHER-STRENGTH METALS
M. V. Pridantsev 28 Jun. 1965 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Met. i Gornoye Delo (Moscow), no. 6, 1964 p 3-9 Presented at the Gen. Meeting of the Dept. of Phys. Chem. and Technol. of Inorg. Mater., Acad. of Sci. USSR, Jun. 1964
(JPRS-30811; TT-65-31350) CFSTI: $1.00

The technology for development of higher strength metals is reviewed. Areas surveyed are low alloyed, increased strength steels; high strength stainless and acid-stable metallic materials; and heat resistant materials. The effects of processes, temperature, alloy additions, and protective coatings are discussed. Composition graphs are presented. L.S.

N65-27064# Aluminum Co. of America, New Kensington, Pa. Alcoa Research Labs.
EVALUATION OF FRACTURE CHARACTERISTICS OF ALUMINUM ALLOYS AT CRYOGENIC TEMPERATURES
J. G. Kaufman and Marshall Holt [1964] 29 p refs Presented at the Cryog. Eng. Conf., Philadelphia, Aug. 1964

Fracture characteristics reflect the resistance of materials to rapid crack propagation and low-ductility "catastrophic" fracture. Tensile properties and notched-bar impact values have been used for many years, but are generally relatively insensitive, and at best, qualitative indicators. The results of notch-tensile tests provide measures of relative notch sensitivity, but are generally qualitative and require careful interpretation; notch-strength ratio is related to tensile efficiency, but notch-yield ratio provides a more meaningful measure of inherent toughness. Tear resistance is a useful indicator of resistance to rapid crack propagation, as shown by the direct correlation of unit propagation energy and stress-intensity factor from fracture-toughness tests; it is applicable for all aluminum alloys, regardless of their ductility. Fracture-toughness tests provide design information, and hence are of maximum value for the evaluation of cryogenic toughness; however, fracture-mechanics techniques are not applicable to many aluminum alloys, and can be misleading if inappropriately applied. Author

N65-27078# Southern Research Inst., Birmingham, Ala.
MECHANICAL AND PHYSICAL PROPERTIES OF TZM MOLYBDENUM ALLOY SHEET AND OF TUNGSTEN SHEET Quarterly Progress Report, 1 Mar.-1 May 1965
Paul G. Adams and Clifford L. Dotson 28 May 1965 51 p
(Contract N600(19)59530)
(QPR-10; AD-615591)

Progress is reported on a program to determine preliminary design information for tungsten and TZM molybdenum sheet produced in Phase I of the Refractory Metal Sheet Rolling Program. During the report period, all the scheduled notched- and unnotched-tensile evaluations for determination of the notched-tensile brittle-ductile transition temperature on the 0.060-in. tungsten sheet and the 0.040-in. TZM sheet as scheduled in the original program were completed. Density measurements were made on the different sheets of various thicknesses of the tungsten and TZM material evaluated under the original scope of the program. Elevated-temperature unnotched-tensile evaluations at 2200, 2500, and 3000° F were conducted on the TZM sheets as specified in the extended phase of the TZM program. The notched- and unnotched-tensile evaluations for analysis of the notched-tensile brittle-ductile transition temperature among different sheets and heats were also completed for the extended work on the TZM sheet. N.E.A.

N65-27079# Mellon Inst., Pittsburgh, Pa.
CORRELATION OF WELD MICROSTRUCTURES WITH FRACTURE TOUGHNESS OF 18% NICKEL (250) GRADE MARAGING STEEL
J. B. Tobias and G. K. Bhat 28 Feb. 1965 157 p refs
(Contract Nonr-4595(00)(X))
(AD-615425)

A program designed to obtain a correlation between fracture toughness and microstructural features of 18% nickel maraging steel plate weldments prepared by various techniques has been partially completed. Results of this study have shown that the center-of-the-weld possesses the lowest fracture toughness for all weldments and that the welding techniques may be listed as follows: Big Tig, Tig, Mig, and submerged-arc. Macrostructural and microstructural examinations of typical weldments, as well as examination of macro-topographies and micro-topographies of fractures of weldments prepared by these four techniques, have shown that submerged-arc weldments present lower resistance to crack travel than do the weldments of the multi-pass inert gas

shield arc techniques. In addition, the embrittling and cracking problem in submerged-arc weldments have been tentatively associated with the formation of an ordering AlTi phase. Author

N65-27110# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
OXIDATION OF RENE 41 AND THORIATED NICKEL WIRES BETWEEN 1600 F AND 2000 F
Robert A. Rosenberg (M.S. Thesis) Jun. 1964 100 p refs
(MECH/GAW-18-64; AD-610241)

Oxidation rates of 10 and 20 mil nickel-base superalloy wires, Rene 41 and Thoriated Nickel, were measured over the range 1600 F to 2000 F for up to 1000 minutes using gravimetric methods. Rene 41 wire oxidation was characterized by the rapid growth of Al_2O_3 caused by a high concentration gradient of aluminum. Formation of this protective Al_2O_3 scale resulted in much slower oxidation of chromium from the normal parabolic rates observed for 50 mil Rene 41 sheet. A theoretical analysis based on diffusion theory for cylindrical shapes was presented to explain the measured oxidation rates. TD Nickel oxidation exhibited a parabolic rate of reaction, controlled by the growth of NiO. Both alloys suffered increases in oxidation rates with increases in temperature. Oxidation of Rene 41 wire increased with the application of stress, while TD Nickel oxidation was insensitive to stress. Internal oxidation (Al_2O_3) of Rene 41 occurred, whereas the high density surface scale of TD Nickel and lack of alloys within its matrix prevented internal oxidation. Neither alloy appeared sensitive to a decrease in O_2 partial pressure. Author

N65-27111# Naval Research Lab., Washington, D. C. Metallurgy Div.
MARINE CORROSION STUDIES: DEEP OCEAN TECHNOLOGY. STRESS CORROSION CRACKING. CATHODIC PROTECTION Second Interim Progress Report
B. F. Brown, T. J. Lennox, Jr., ed., R. L. Newbegin, M. H. Peterson, J. A. Smith et al Nov. 1964 51 p ref
(NRL-1574; AD-610551)

Precracked cantilever stress-corrosion cracking tests on notched and fatigued specimens of high strength steels showed an increase of stress intensity from about 15% of the breaking strength of a dry precracked bar of steel having a yield strength of 200 ksi to about 65% for the same steel after heat treatment to a yield strength of 125 ksi. Corrosion caused by sea-water was found on stainless steel heat exchangers and on bare 5086-H32 aluminum alloy. The alloy corrosion was accelerated by coupling with noble metals. Also reported are studies on the effect of: cathodic protection on crevice and pitting corrosion of stainless steel; current distribution along a wire rope cathode; cathodic protection of wire rope; pressure on a steel cathode in a sodium chloride solution; and an aluminum anode cathodic protection for a Coast Guard vessel. G.G.

N65-27117# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PRECIPITATE PARTICLES IN DILUTELY ALLOYED URANIUM QUANTITATIVE METALLOGRAPHY
K. N. Woods, Y. E. Smith, and R. D. Leggett Jan. 1965 41 p refs
(Contract AT(45-1)-1830)
(BNWL-30) CFSTI: $2.00

A quantitative metallographic technique for studying the size distribution of micron and submicron second-phase particles present in dilute, uranium-base alloys is described. An electrolytic etching technique was used for delineating the precipitated second phase in unirradiated dilute uranium–iron–silicon alloys. The precipitate particles were measured on a particle size analyzer for estimating their total density, volume fraction, and size distribution. Three independent methods of calculation were applied to determine the distribution curves. Results indicate that the electrolytic etching technique shows promise for delineating second-phase precipitate particles of 0.1 to 1 microns in dilute alloys of uranium, that a U^{180} ppm Fe^{90} ppm Si alloy reacts to solutionizing and precipitation treatments in accordance with established theories and published solubility data, and that peaks of particle size distributions of some specimens can only be revealed by reducing the resolution point from approximately 0.1 micron to 0.02 micron or less. L.S.

N65-27159# Arde-Portland, Inc., Paramus, N. J.
INVESTIGATION AND OPTIMIZATION OF HIGH STRENGTH ALLOYS FOR CRYOGENIC STRETCH-FORMING Quarterly Technical Report, 1 Jan.–31 Mar. 1965
Roger Mc Donough [1965] 18 p
(Contract NOw-65-0193-f)
(QTR-1; AD-615627)

Investigations are continuing on the development of high strength alloys with good fracture toughness suitable for cryogenic stretch-forming into high performance rocket motor cases. Specimens of commercially available 301 were cryogenically stretched, fatigue cracked, and tested in order to establish test procedures. This heat was shown to be very tough with notch ratios close to 1. Two residual heats of material from a previous program were cryogenically prestrained, fatigue cracked, aged, and tested. The chemistries and test results of the heats are tabulated. The biaxial test fixture design was completed and reviewed. R.N.A.

N65-27214# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATING OXIDATIONS OF NIOBIUM–TITANIUM–ZIRCONIUM ALLOYS
D. A. Prokoshkin, Ye. V. Vasil'yeva, and A. M. Ryabyshev 26 Mar. 1965 11 p refs Transl. into ENGLISH from Tr. Inst. Met., Akad. Nauk SSSR (USSR), no. 13, 1963 p 157–162
(FTD-TT-64-1037/1+2; AD-614017)

The oxidation kinetics of niobium base alloys with constant titanium contents of 5% and 10% by weight were investigated in air at 1000° to 1200° C. The zirconium content in the alloys varied from 0.5% to 25% by weight. The addition of up to 5% zirconium increased the oxidation rate of the niobium–titanium alloys. Zirconium additions over 5% decreased the oxidation rate. Alloys with 5% of titanium had a higher oxidation rate than alloys with a 10% content. An X-ray structural analysis of the alloy scales showed that a reduction in the oxidation rate of alloys containing more than 5% zirconium was due to the formation of $6Zr_2Nb_2O_5$ in the scale. The oxygen diffusion rate through the lattice of this compound was lower than through the lattice of niobium–titanium alloys. R.N.A.

N65-27271*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
STUDIES OF ALKALI METAL CORROSION ON MATERIALS FOR ADVANCED SPACE POWER SYSTEMS. Quarterly Progress Report No. 3, Dec. 26, 1964–Mar. 26, 1965
R. W. Harrison [1965] 30 p refs
(Contract NAS3-6012)
(NASA-CR-54390) CFSTI: HC $2.00/MF $0.50 CSCL 20F

The influence of stress on the corrosion behavior of an advanced refractory alloy in potassium, and the corrosion mass transfer effects in a stainless steel–columbium alloy potassium system are investigated. The potassium was transferred directly to an alloy reflux capsule from the final hot trapping

container, and the capsule was sealed by electron beam welding in a vacuum of 7×10^{-6} torr. The results showed the oxygen in the potassium taken from the fill tube to be 5 ppm, and the oxygen in the potassium taken from the chamber samples to be 8 ppm. The stainless steel capsules were opened in an argon atmosphere and drained of potassium. After removal of the Cb–1Zr alloy sheet specimens, the capsules and specimens were cleaned and examined. No appreciable differences in appearance of the internal surfaces of any of the capsules were noted from visual observation. R.W.H.

N65-27284# Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center.

EFFECTS OF INTERSTITIAL IMPURITIES ON THE MECHANICAL PROPERTIES OF ELECTROREFINED VANADIUM AT LOW TEMPERATURES

David R. Mathews, G. H. Keith, and E. A. Loria 1965 27 p refs (BM-RI-6637)

Electrorefined vanadium was evaluated with respect to tensile properties and the effects of interstitial contaminants in the temperature range of 77° to 273° K. The yield strength of 18,500 psi and hardness of 63 diamond pyramid hardness (DPH) of electrorefined vanadium are approximately equal to that of iodide crystal bar vanadium. The ductile-brittle transition temperature was found to be below 77° K, but with 0.175 weight-percent oxygen or 0.10 weight-percent nitrogen, it increased to between 123° and 190° K. With carbon content up to 0.11 weight-percent, the transition temperature remained below 77° K. The yield strength of the interstitial-containing alloys can be expressed by: $\sigma_u = 7.5 + 480$ (pct N) + 290 (pct O) + 280 (pct C), where σ_u is the upper yield stress in 1,000 psi at 273° K. Profuse deformation twinning occurred in the alloys tested at 77° K. However, twinning could be suppressed by dissolved oxygen or nitrogen in excess of 0.15 and 0.086 weight-percent, respectively. Carbon, even though present in excess of the solubility limit, did not affect twinning. Author

N65-27294*# Bausch and Lomb, Inc., Rochester, N. Y. Grating Research Section.

GRATING GROOVE FORMATION IN Au AND Au–Ge ALLOYS Final Report, 1964

C. Frank Mooney 26 Mar. 1965 48 p

(NASA Order R-107; Contract Nonr-4277(00) (X))

(NASA-CR-63480) CFSTI: HC $2.00/MF $0.50 CSCL 13H

Summary sheets on grating groove formation in Au and Au–Ge alloys are presented. Included are conditions observed during filming and in ruling setup, schematic forms of the grating profile, electron micrographs, and graphs on the absolute reflectance and cumulative diffractance of the film. R.N.A.

N65-27309# Titanium Metals Corp. of America, New York.

DEVELOPMENT OF A STABLE-BETA TITANIUM ALLOY Eighth Quarterly Report, Apr. 1–Jun. 30, 1964

D. B. Hunter [1964] 49 p refs

(Contract DA-30-069-ORD-3743)

(WAL-TR-405/2-7; AD-612477)

Quenching Ti-17V-10CR-3Al-1Si from the beta field and aging at 1300–1400F indicated that the upper aging temperature limit to achieve hardening without visible microstructural change was 1300–1350F. A reduction in either solution temperature or time reduced the subsequent hardening response of this alloy. Brittleness in such alloys is ascribed partly to the large grain size produced by the high temperatures required for silicide solution. Cold rolling pressure determinations were made on the stable-beta alloys Ti-17V-10Mn-3Al and Ti-8Mo-8V-6Fe-3Al. Room temperature tensile tests on minor compositional variations of ageable beta alloys Ti-17V-4Fe-3Al and Ti-8Mo-8V-2Fe-3Al indicated that a high proportion of alpha phase stabilizing elements to beta phase stabilizing elements resulted in a faster aging response; variations in total alloy content were less significant. Statistical determinations of the relationship between Vickers hardness and ultimate tensile strength indicated that in both alloys 17 Vickers points were equivalent to 10,000 psi. Creep tests on Ti-17V-4Fe-3Al indicated that with exposure at 600F and 141,000 psi load, after 150 and 500 hours deformations were 0.327 and 0.512%, respectively. Complete substitution of Co for Fe in two stable-beta alloys produced ageable beta alloys with excellent combinations of strength and ductility after aging. Author

N65-27337# Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.

GRAIN BOUNDARY RELAXATION IN FOUR HIGH PURITY, FACE-CENTERED CUBIC METALS Technical Report, Mar. 1963–Mar. 1965

James N. Cordea and Joseph W. Spretnak Wright-Patterson AFB, Ohio, AF Mater. Lab., Apr. 1965 155 p refs

(Contract AF 33(657)-7656)

(AFML-TR-65-116; AD-615570)

The grain boundary relaxation in high purity aluminum, nickel, copper, and silver was studied by means of a low frequency torsion pendulum. Both internal friction and creep at constant stress tests were conducted on all the metals. A lognormal distribution in relaxation times was used to explain the relatively wide experimental internal friction peaks and the gradual relaxation behavior during the creep tests. The lognormal distribution in relaxation times was separated further into a lognormal distribution of relaxation time constants and a normal distribution in activation energies. A spread of from ± 4 to ± 6 Kcal/mole accounted for the major part of the distribution. The distribution parameter β was observed to increase with increasing grain size in copper. Grain boundary segregation is suspected to be the cause. A "double peak" internal friction phenomenon observed in copper is explained by the segregation of minute quantities of oxygen to the grain boundary. The preferred orientation of grains in the wire specimens also appears to be an important factor. A similar double peak was also observed in high purity silver. The activation energy of the second peak is $H_m = 55.5 \pm 4$ Kcal/mole. The activation energies derived from the grain boundary relaxation peaks are H_m (Al) = 34.5 ± 2 Kcal/mole, H_m (Ni) = 73.5 ± 4 Kcal/mole, H_m (Cu) = 31.5 ± 4 to 38.5 ± 4 Kcal/mole, and H_{m1} (Ag) = 41.5 ± 4 Kcal/mole. A definite relationship exists between stacking fault energies and the relaxation strengths of the metals investigated. The higher the stacking fault energy, the larger is the grain boundary relaxation strength. Author

N65-27361*# Atomics International, Canoga Park, Calif.

SOLUBILITY STUDIES OF ULTRA PURE TRANSITION ELEMENTS IN ULTRA PURE ALKALI METALS Quarterly Report No. 7, Jan. 3–Apr. 3, 1965

R. L. Mc Kisson and R. L. Eichelberger 2 Jun. 1965 35 p refs

(Contract NAS3-4163)

(NASA-CR-54097; AI-65-93) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Methods for defining the solution process and determining the equilibrium solubility of highly purified transition metals and selected compounds in highly purified liquid alkali metals are under study. Data were obtained for the solution of high purity iron, niobium, and molybdenum in high purity potassium. A modification was made in the quench apparatus and the new

water-cooled device was more effective than the chill-blocks previously used. Cooling the sample capsule to below the melting point of potassium was achieved in less than 20 minutes. This limits the time during which the dissolved solute may have the mobility required to deposit on, and to diffuse into, the collector walls. Results are summarized and given in tabular form. R.W.H.

N65-27365*# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.

DAMAGE TO SOLIDS CAUSED BY CAVITATION

Frederick G. Hammitt [1965] 48 p refs Presented at Royal Society Discussion on Deformation of Solids Due to Liquid Impact, London, 27 May 1965 *Its* Rept.-03424-26-1

(Grants NsG-39-60; NSF G-22529)

(NASA-CR-63619) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The full range of cavitation damage, from theoretical bubble-dynamics to practical aspects, are under study. Crater-type pits of a large depth-to-diameter ratio were observed on stainless steeel in a centrifugal pump test in a high-temperature alkali metal. Venturi test observations showed that a ridge, raised around the craters, was predominantly on the downstream side of the crater. The existence of a ridge suggested that the craters were formed by single-bubble implosions. A preliminary series of tests on stainless steel specimens under varying degrees of tensile load were completed. Among the results obtained were: (1) the effect of the applied tensile strength on cavitation damage rate was small, although the damage was increased by the larger applied stresses; and (2) the effect upon yield and ultimate strengths of a measured mean depth of penetration due to cavitation attack was measured, and found to agree with an estimation based on localized depth of penetration as measured from a microsection. It is concluded that it is not possible to predict cavitation damage in a prototype machine from laboratory tests. Therefore, it is necessary that tests model prototype systems accurately. R.W.H.

N65-27407# Atomic Energy of Canada Ltd., Chalk River, Ontario.

THE EFFECT OF SPECIMEN GEOMETRY ON THE TENSILE PROPERTIES OF SOME ZIRCONIUM ALLOYS

C. C. Sanderson Mar. 1965 35 p refs

(AECL-2207) Available from Atomic Energy of Canada Ltd., Chalk River: $1.00

The effects of specimen geometry on the tensile properties of Zircaloy-2, Zr-2.5 wt.% Nb, and Zr-2.5 wt.% Nb–0.5 wt.% Cu in a variety of metallurgical conditions have been investigated using two types of tensile specimen. With flat tensile specimens, little effect on tensile properties was observed for specimen width-to-thickness ratios ranging from 2 to 8 in room temperature and 300° C tests. In the ring tensile tests, however, where the width-to-thickness ratio was varied from 2 to 18, variations in ultimate tensile stress and total elongation and reduction of area were observed. It is concluded that specimen geometry is of little importance for flat tensile specimens. In ring specimens, however, the tensile properties are dependent on width-to-thickness ratio and it is recommended that the ratio should be such that a minimum amount of longitudinal restraint is imposed on the specimen by the grips. Author

N65-27424# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.

FIRE HAZARDS ASSOCIATED WITH THE USE OF TITANIUM IN AIRCRAFT

D. J. Maykuth and R. H. Ernst Jun. 1964 9 p refs

(AD-609342)

Ignition and combustion conditions of titanium aircraft components and actual cases of such fires are reviewed. Commercially pure titanium and several of its alloys can be ignited using an oxyacetylene torch. The sensitivity of titanium toward ignition and combustion in oxygen atmospheres increases with increasing oxygen pressure and concentration so that with sufficiently high pressures and concentrations, burning can occur at appreciably lower temperatures. Once ignited, titanium sheet will continue to burn in the presence of a high velocity airstream. Superficial burning was observed on titanium components subjected to moderate temperatures and high rubbing velocity friction loads in air. A thermite reaction can be initiated on an unheated alloy by subjecting it to molten droplets of mild steel in the presence of a high velocity air jet. Sliding friction of titanium on bare or foamed runways can cause friction sparking capable of igniting fuel mists. Reports on aircraft gas-turbine fires involving titanium engine components suggest that these fires were caused by the rubbing friction of titanium parts. R.N.A.

N65-27524# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.

OXIDATION OF NICKEL- AND COBALT-BASE SUPERALLOYS

Carl H. Lund (Martin Metals Co.) and Herbert J. Wagner 1 Mar. 1965 34 p refs

(Contract AF 33(615)-1121)

(DMIC-214; AD-614707)

This report presents information dealing with the oxidation of nickel- and cobalt-base superalloys. All of the superalloys will oxidize at high temperatures when oxygen is present in the enveloping atmosphere. The rate of oxidation depends upon alloy composition, temperature, oxygen concentration, oxides formed, diffusion rates of the metals in both base metal and oxide, diffusion rate of oxygen in the oxide, solubility of oxygen in the matrix, and a host of other variables. The effects of oxidation can be beneficial or they can be harmful. The first section of this report deals with the fundamentals of the oxidation of Ni-Cr and Co-Cr alloys. Subsequent sections discuss general surface oxidation, intergranular oxidation, other subsurface oxidation, and the effect of stress on the rate of oxidation. Numerous specific alloys are mentioned in the report; as an aid to the reader, the appendix contains an alloy index of the alloys mentioned in the report along with the compositions of the alloys, and the pages on which mention of the alloys is made. Author

N65-27583# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

X-RAY EXAMINATION OF THE ORDERING PROCESS IN ALLOYS

V. I. Iveronova 1 Apr. 1965 13 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 8, no. 2, 1963 p 157–162

(FTD-TT-64-1056/1+2; AD-614387)

The state of modern roentgenographic methods for investigating short-range and long-range order in alloy structures is discussed. Problems of calculating orderliness parameters in diffusion-dispersion equations are analyzed for studying close orderliness in hardened alloys. L.S.

N65-27584# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEW 5KhGSVF FORGING STEEL

G. S. Keylin and T. A. Sitnikova 30 Mar. 1965 7 p Transl. into ENGLISH from Med. Prom. SSSR (Moscow), v. 18, no. 1, 1964 p 47-48

(FTD-TT-65-37/1; AD-614390)

A nickel-free forging die steel 5KhGSVF was developed, and has the following chemical composition: 0.45–0.55% carbon, 1.1–1.4% chromium, 0.8–1.1% manganese, 0.5–0.9% silicon, 0.5–0.8% tungsten, 0.10–0.20% vanadium, and not more than 0.035% sulfur and phosphorus. A table is given showing the dependency of the steel's mechanical properties on the drawing temperature. Testing sample of dies manufactured from the steel, indicates that 5KhGSVF steel completely satisfies the high requirements needed for hammar dies, and is a superior replacement to nickel steels 5KhNV, 5KhNM, and 5KhNT. The nickel-free steel is recommended for application in factories of the medical-instrument density. LS.

N65-27604# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

STABILITY OF HIGH-NICKEL ALLOYS IN SUPERHEATED STEAM

F. A. Comprelli and U. E. Wolff Washington, AEC, Nov. 1964 87 p refs

(Contract AT(04-3)-189)

(GEAP-4745) CFSTI: $3.00

The room temperature tensile properties and microstructural characteristics of superheat cladding materials were evaluated as a function of exposure at 1050 and 1150° F for periods up to 10,000 hours. The alloys of interest for superheat reactor applications are the solid solution alloys: Hastelloy-X, Inconel-625, Incoloy-800, Incoloy-825, and Inconel-600. These alloys, when subjected to prolonged exposure at these temperatures, exhibit metallurgical changes which affect the properties of the material. The test results indicated that each alloy was subject to some degree of thermal instability after very long exposure at temperature, as evidenced by carbide precipitation, a progressive strengthening of the alloy, and a corresponding reduction in ductility. Author

N65-27612# Bureau of Mines, Pittsburgh, Pa. Pittsburgh Metallurgy Research Lab.

REMOVING COPPER FROM COPPER-CLAD STEEL BY OXIDATION

R. J. Leary 1965 15 p refs

(BMI-RI-6647)

Oxidation testing of copper-clad steel strip was performed in a muffle furnace to determine whether copper in contact with steel scrap could be removed by oxidation in an airstream at high temperatures. Substantially all of the copper was oxidized before any signif.cant iron oxidation occurred. The rate of copper oxidation was not affected by contact with iron. Copper oxide scale separated spontaneously from the underlying metal during cooling. Results indicate the possibility of removing light-gage copper coatings and components from ferrous scrap by oxidation in an incineration process. Author

N65-27644*# Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy.

MODIFIED EUTECTIC ALLOYS FOR HIGH TEMPERATURE SERVICE Interim Report, 1 May 1964–1 May 1965

R. L. Ashbrook and J. F. Wallace [1965] 95 p refs

(Grant NsG-639)

(NASA-CR-63473) CFSTI: HC $3.00/MF $0.75 CSCL 11F

The high temperature eutectics Co-10 Al, Co-42 Cr, Co-37 Mo, Co-45 W, Ni-37 Ta, Ni-45 W, and Ni-16 Zr were modified by small additions of Mg, Ca, Y, Ce, La, Ti, Zr, B, Al and C. Unmodified and modified melts were vacuum melted and solidified at three cooling rates and as investment cast test bars. The results of stress rupture tests in air at 1800° F showed modification capable of producing substantial improvements in properties. Small additions of B, C, and Ti increased the stress rupture lives of the Co-10 Al, Ni-37 Ta, Co-45 W and Ni-45 W up to 23 times and increased room temperature ductility from less than 1 percent to as high as 7.5 percent. Author

N65-27657# Carnegie Inst. of Tech., Pittsburgh, Pa. Metals Research Lab.

RESEARCH ON THE DEFORMATION OF METAL CRYSTALS Final Report, Oct. 1963–Nov. 1964

G. T. Horne and P. J. Wray Wright-Patterson AFB, ARL, Jan. 1965 39 p refs

(Contract AF 33(615)-1068)

(ARL-65-19; AD-615006)

The stress relaxation of zone-refined iron is found to be logarithmic with respect to time at 77° K. From consideration of the effect of impurity, the strain dependence above the macroscopic yield stress, and the activation volumes derived for the relaxation mechanism, it is concluded that the same rate controlling mechanism is common to the plastic yield, creep and stress relaxation of iron. At intermediate temperatures, ~200° C in Fe-C alloys, a strengthening mechanism is indicated by a maximum in ultimate tensile strength. An investigation of the phenomenon has been conducted on mild steel specimens in the temperature range 0° –400° C. Author

N65-27680*# National Aeronautics and Space Administration, Washington, D. C.

PROPERTIES OF COMPOSITE MATERIALS, REINFORCED BY TRICHITE FILAMENTS (WHISKERS) [LES PROPRIETES DES MATERIAUX COMPOSITES RENFORCES PAR LES FILAMENTS DE TRICHITES (WHISKERS)]

H. de l'Estoile May 1965 16 p refs Transl. into ENGLISH from Doc-Air-Espace (France), no. 90, 1965 p 19–24

(NASA-TT-F-9372) CFSTI: HC $1.00/MF $0.50 CSCL 11D

A brief review is given over properties of composite materials, reinforced by whiskers formed of filaments of graphite, iron, silver, copper, quartz, zinc, cadmium, and aluminum oxide, with tabulation of their mechanical properties and stress-strain diagrams. The ultimate strength, at various stresses and strains, is calculated for a typical example of aluminum whiskers forming 50 vol.% in titanium-molybdenum alloys, certain steels, and columbium alloys. The use of a René 41 steel, reinforced with 50% of aluminum whiskers, will reduce the weight at a ratio of 4 to 1 in the construction of a pressurized enclosure, provided that the whiskers are oriented in accordance with the isotensoid. A composite material with 12 vol.% oriented aluminum whiskers will be about 10 times stronger than a nonreinforced light alloy. Author

N65-27681*# National Aeronautics and Space Administration, Washington, D. C.

THE EFFECT OF ALLOYING ON THE PHYSICOMECHANICAL PROPERTIES OF NIOBIUM [VLIYANIYE LEGIROVANIYA nA FIZIKO-MEKHANICHESKIYE SVOYSTVA NIOBIYA]

N. D. Tarasov, R. A. Ul'yanov, and Ya. D. Mikhaylov (Kharkov Inst. of Tech. Phys.) May 1965 12 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 18, no. 5, 1964 p 740–745

(NASA-TT-F-9374) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Experimental studies on the effect of alloying in general and of alloys of niobium with B, La, Si, Cr, Re, Zr, Ir and other elements in particular on the mechanical properties of the alloy at high temperatures (up to 1300° C) are given, with tabulated and plotted data. Alloying of niobium in the region of solid solutions increases the tensile strength and decreases

the plasticity at room temperature. The maximum strengthening effect is obtained in niobium alloys with Cr, Re, Zr and Ir. With increasing concentration of the solid solutions, Young's modulus and the high-temperature tensile strength increase further. Author

N65-27871# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
INVESTIGATION OF BONDING IN OXIDE-FIBER (WHISKER) REINFORCED METALS Quarterly Report No. 1, 1 Jul.–30 Sep. 1964
Willard H. Sutton and Earl Feingold Watertown, Mass., Army Mater. Res. Agency, 30 Sep. 1964 24 p refs
(Contract DA-19-066-AMC-184(X))
(AMRA-CR-65-01/1; AD-458220)

Trace impurities in nickel were found to affect its wetting, its interfacial energy and its adherence to sapphire (α-Al_2O_3). Sessile drop experiments conducted in vacuo (5×10^{-6} Torr) at 1500° C ±20° C revealed a 10° difference in contact angle for two different samples of high purity nickel (99.996+%) on sapphire substrates. The room temperature shear strength (strength between the solidified nickel and Al_2O_3) was 13,200 psi and 23,700 psi for the two nickel specimens. A detailed investigation of the Ni-Al_2O_3 interface was conducted using X-ray diffraction analysis and electron microscopy. Author

N65-27917# Nuclear Metals, Inc., Concord, Mass.
FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. DEVELOPMENT OF URANIUM-BASE ALLOYS STRENGTHENED BY SLIS TECHNIQUES Summary Technical Report, 1 Jul. 1963–30 Jun. 1964
A. R. Kaufmann and W. C. Muller Washington, AEC, 2 Dec. 1964 85 p
(Contract AT(30-1)-2784)
(NMI-1262) CFSTI: $3.00

A program was conducted to develop new improved uranium-base alloys by the SLIS (soluble in the liquid state and insoluble in the solid state) technique in which dispersions are achieved with metallic particles rather than oxides. The alloying elements are those which are highly insoluble in the solid state and, thus, have little tendency to agglomerate at elevated temperatures. U–Be, U–C, U–Be–C, and U–Al–Si alloys were prepared by dissolving the alloying elements in liquid uranium and then quenching rapidly by splatcooling. Results indicate that the strength of splatcooled uranium can be increased at 600° C with additions of up to 0.4 w/o beryllium metal. Little change in the strength of the U–Be alloy occurs after aging at 600° C. After aging for 100 hours at 600° C, the U–C splatcooled alloy showed little strength improvement at 600° C with respect to unalloyed uranium at a similar test temperature. The program demonstrates that it is possible to achieve particles less than 0.01 diameter at concentrations of 10^{12} to 10^{13} particles per cubic centimeter by the splatcooling technique. R.N.A.

N65-27962# Stanford Univ., Calif. Dept. of Materials Science.
STRUCTURE OF DEFORMED INTERNALLY OXIDIZED ALLOYS Technical Report No. 14
John L. Brimhall and Robert A. Huggins Feb. 1965 32 p refs
(Contract Nonr-225(34))
(SU-DMS-65-3; AD-614080)

The structure of deformed internally oxidized alloys of silver containing magnesium and copper containing aluminum were studied by thin film transmission electron microscopy. With low to moderate amounts of strain, the deformation structure in the dispersion-hardened alloys was found to consist of a high density of dislocations arranged in a random distribution or in a very fine, but poorly defined, cell structure, depending on the fineness of the dispersion and amount of deformation. In contrast, both pure copper and silver show relatively large, distinct cell structures. The particular structures in the alloys are believed to result from particles acting as both dislocation sources and deflectors. The lack of a pronounced deformation can also be traced to the formation of dislocations on many slip systems and a lack of local concentrations of dislocations of predominantly one sign. Author

N65-27965# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
THE INVESTIGATION OF MICROSTRUCTURE IN STRUCTURAL CERAMICS
H. M. Burte and L. A. Jacobson Jan. 1965 29 p refs Presented at the Symp. on Ceram. for Space, 66th Ann. Meeting of the Am. Ceram. Soc., Apr. 1964
(AFML-TR-65-10; AD-614026)

The importance of understanding and controlling the effects of microstructure on the properties of ceramics for space and nuclear applications has become well established in recent years, and several introductory reviews are available. It is now appropriate to focus attention on defining pacing problems and the most fertile areas for future effort. This is attempted for the mechanical, thermal, and chemical properties underlying the structural use of ceramics. A dimensional range from subgrain features of polycrystalline bodies to the micromechanics of composities is considered. The status of experimental methods for characterizing microstructure is discussed, as is the importance of improved experimental substances. One pacing factor is the ability to synthesize or prepare desired iccrostructures with controlled variations, in order to further research into microstructural effects as well as to provide a basis for subsequent technology. Author

N65-27971# Honeywell, Inc., Hopkins, Minn. Honeywell Research Center.
FABRICATION AND FRACTURE OF POLYCRYSTALLINE NiO Third Interim Technical Report
W. B. Harrison Mar. 1965 51 p refs
(Contract DA-11-022-ORD-3441)
(AROD-2884-3; AD-614263)

High purity, sub-micron NiO powders have been obtained by the preparation and pyrolysis of nickel oxalate. The grain growth and densification of these sub-micron particles was studied under various sintering atmospheres and under various hot pressing conditions. Sintering produced 6-17μ NiO with a density as high as 96% of its theoretical x-ray density of 6.805 gm/cc. Such material in the as-machine state had a zero transverse strength of 23,700 psi. Localized concentrations of grain boundary porosity appeared to be the source of failure in sintered NiO. Hot pressing produced 2μ NiO with less than 2% porosity. When a closed pore state was reached at about 3.5% porosity, gases were entrapped within the NiO which expanded and apparently introduced grain boundary microcracks into the NiO structure. Such material fractured at stresses as low as 5,000 psi. at room temperature. The heat treatment of such material removed these stresses and increased its strength to as high as 18,300 psi. Mechanical polishing increased the room temperature strength to 23,000 psi. and its 650° C strength to 24,400 psi. No evidence for a rhomberhedral transformation in this fine grained, polycrystalline NiO was observed. Author

N65-27973# Reactive Metals, Inc., Niles, Ohio.
PROCESSING STUDY OF Ti-7Al-2Cb-1Ta Final Summary Report
S. R. Seagle, L. R. De Blasio, and O. Bertea 1 Feb. 1965 68 p ref
(Contract N161-25741)
(AD-466007)

Continued progress under a program designed to evaluate various processing techniques for increasing the yield strength of Ti-7Al-2Cb-1Ta plate while maintaining satisfactory ductility and fracture toughness, is reported. Using material from the same heat, 1" thick plates produced by extrusion, rolling on a planetary mill, and rolling on a 2-high plate mill, were evaluated for tensile properties and fracture toughness. Analyzed were the following three methods for improving the strength of the plates: low temperature processing, water quenching after rolling or annealing at temperatures near the beta transus, and aging at 1100°F after quenching treatment. Of the three processes tested, the second and third showed the greatest potential for scale-up to large plate processing. However further evaluation is required before current yield strength specifications can be increased. S.C.W.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-26922*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
INFLUENCE OF CONSTITUENT PROPERTIES UPON THE STRUCTURAL EFFICIENCY OF FIBROUS COMPOSITE SHELL
B. Walter Rosen and Norris F. Dow Apr. 1965 30 p refs Presented at AIAA 6th Struct. and Mater. Conf., Palm Springs, Calif., 6 Apr. 1965
(Contract NASw-1144)
(NASA-CR-63452; R65SD16) CFSTI: HC $2.00/MF $0.50 CSCL 11D

The application of fibrous composites to aerospace structures subjected to compressive loads is treated analytically. For boost-vehicle shells, axial compression loadings are found to be low, so that efficiency of filament-reinforced composites for this application depends primarily upon their elastic buckling characteristics. In this study emphasis is placed on the evaluation of elastic shell buckling properties of a wide variety of combinations of filament and binder materials in a number of structural configurations. The influence of filament and binder moduli, filament orientation, hollow filaments, and various effectivenesses of auxiliary stiffening are considered, and the over-all weight-efficiencies are compared with shells made from available structural metals. Author

N65-27007 Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
AIR FORCE REQUIREMENTS AND PROGRAMS PLASTICS
Robert C. Tomashot *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 8 p (See N65-27000 16-34)

The Air Force needs or requirements in plastic technology have been most critical with respect to improving the structural properties and the retention of these properties at elevated temperature. Emphasis on the structural aspect implies that the plastic be of the fibrous reinforced type. Approaches to improvements in the area of reinforced plastic are presented. N.E.A.

N65-27012 Budd Co., Newark, Del. Polychem Div.
STATE OF THE ART IN PLASTICS
Ernest O. Hausmann *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 6 p (See N65-27000 16-34)

A brief survey of some of the significant advances made during the last year in the major industrial fields based upon polymer technology is presented. This include plastics, elastomers (or rubbers), adhesives and sealants, foams, and protective coatings. Within these classes, new materials, new and improved processes and new applications are discussed. N.E.A.

N65-27059*# Stanford Research Inst., Menlo Park, Calif.
SPACE ENVIRONMENT EFFECTS ON POLYMERIC MATERIALS Interim Technical Report No. 2, Aug. 1964-May 1965
R. F. Muraca 30 May 1965 74 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950324)
(NASA-CR-63529) CFSTI: HC $3.00/MF $0.75 CSCL 11J

The principles and techniques involved in the determination of weight loss and volatile condensable material are discussed in the light of application to polymeric materials being considered for use in spacecrafts. Results are given for the determinations of volatile condensable material in simulated spacecraft environment and the identifications of volatile materials. Data are presented concerning measurements made *in situ* of the behavior of mechanical properties of polymeric substances in simulated spacecraft environment. The commercial elastomers which have been studied include Vitons, Nordels, and Hypalons; of these three, the Vitons appear to be most suitable for spacecraft application. Discussion is presented of a study of the degradation at elevated temperature *in vacuo* of a laboratory-synthesized polyurethane. Author

N65-27063*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FURTHER DEVELOPMENT AND EVALUATION OF M-31 INSULATION FOR RADIANT HEATING ENVIRONMENTS
Vaughn F. Seitzinger 25 May 1965 29 p refs
(NASA-TM-X-53267) CFSTI: HC $2.00/MF $0.50 CSCL 11D

The results of a program for additional development and evaluation of M-31 insulation, a composite material developed specifically to protect the base of the Saturn launch vehicle, are presented. This insulation is comprised of fibrous potassium titanate and asbestos fibers, bonded with colloidal silica. Processing techniques by the manufacturer of potassium titanate resulted in an increase in the bulk density, thermal conductivity, mechanical strength, and drying shrinkage of the insulation. Author

N65-27403# West Virginia Univ., Morgantown. Engineering Experiment Station.
PREPARATION OF WOOD-PLASTIC COMBINATIONS USING GAMMA RADIATION TO INDUCE POLYMERIZATION
James A. Kent, Anthony Winston, William R. Boyle, Wesley Loos, and Joseph E. Ayres Washington, AEC, 14 May 1965 109 p refs
(Contract AT(40-1)-2945)
(ORO-628) CFSTI: $4.00

The investigation of improvement of the mechanical properties of wood by impregnation with suitable polymers is reported. It was found that tough, continuous radiation polymers and copolymers of vinyl chloride can be prepared if suitable plasticizers are used. Also, radiation copolymers of styrene–acrylonitrile appear to be feasible for use in wood–plastic composites. Carbon tetrachloride showed that important reductions in radiation requirements are possible when this compound is used as a promoter for the radiation polymerization of methyl methacrylate. Further, it was found that many polymer dyes accentuate the wood grain and impart attractive colors to the wood. The dyes have inhibitory effects on the polymerization reaction; however, at concentrations which are useful for wood–plastic combinations, the inhibition is not sufficient to cause concern. Exploratory work with radiation polymers and copolymers of formaldehyde indicated that such systems are not practical in wood–plastic combinations. E.E.B.

N65-27591# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.

SOME NEW FREEZE PHOTOELASTIC MATERIALS AND THEIR APPLICATION

Katsuhiko Ito Mar. 1965 28 p refs Transl. into ENGLISH from Rikagaku Kenkyusho Hokoku (Tokyo), v. 30, no. 4, 1954 p 233–248

(RSIC-383; AD-614278)

Detailed studies principally on three dimensional photoelasticity by the freezing method were made of some new materials. These include epoxy resin cured by poly addition reaction, homopolymer or unsaturated alkyd and diallyl phthalate cured by chain copolymerization reaction, and copolymer resins (copolymers: styrol, divinyl benzol, diallyl phthalate and diallyl cyanurate). The properties of these resins vary widely according to type and orientation of starting material, method of synthesis, catalyst, hardener, accelerator or curing conditions. Favorable and unfavorable qualities with respect to freezing were evaluated. Consistency of quality reproducibility and applicability as anisotropic photoelastic material were investigated. Author

N65-27639*# Goodyear Aerospace Corp., Akron, Ohio.

DEVELOPMENT OF A PREDISTRIBUTED AZIDE BASE POLYURETHANE FOAM FOR REGIDIZATION OF SOLAR CONCENTRATORS IN SPACE

N. Jouriles and C. E. Welling Washington, NASA, Jun. 1965 232 p refs

(Contract NAS1-3301)

(NASA-CR-235) CFSTI: HC $6.00/MF $1.25 CSCL 11E

An azide base polyurethane foam optimum formulation is described that can be applied as paste on a membrane structure, can be foam activated and rigidized by the application of heat, and can produce a foam product to meet the design goals of rigidizing a space solar concentrator. Twelve azide structures were investigated, and a prepolymerized polyol resin, a blocked isocyanate, a microquartz filler, various catalysts, surfactants, and plasticizers were examined during the development of the formulation. The foam product was produced and tested in vacuum for physical property values. Tensile ultimate stress values as high as 20 psi and tensile modulus values up to 1385 psi were obtained for foam densities of approximately 4 pcf. Solar concentrators of up to two feet in diameter were foam rigidized in vacuum. Contour measurements on one model gave less than 0.1 inch deviation from a perfect paraboloid over almost all of the surface area. Pictures, tables, graphs, and diagrams are given in presenting the material. L.S.

N65-27647# Minneapolis-Honeywell Regulator Co., Hopkins, Minn.

MECHANICAL PROPERTIES OF POLYCRYSTALLINE SODIUM CHLORIDE Twenty-Eighth Technical Report

R. J. Stokes Mar. 1965 42 p refs

(Contract Nonr-4076(00))

(HR-65-256; AD-614054)

The tensile behavior of fully dense polycrystalline sodium chloride has been correlated with deformation mode at different temperatures. At low temperatures (i.e. < 150° C) there is little plasticity. Slip bands are straight and the strain discontinuity cannot be accommodated at the grain boundaries. Under these conditions brittle cleavage fracture originates from an intergranular source. Above 150° C the onset of wavy slip permits adjacent grains to conform and there is a marked increase in plasticity. Above 200° C deformation is accompanied by grain boundary sliding, polygonization and recrystallization and the specimens elongate for a truly ductile fracture. These observations are compared with recent observations on polycrystalline magnesium oxide. Author

N65-27745# Naval Applied Science Lab., Brooklyn, N. Y. Material Sciences Div.

THE NASL NOTCHED FLAT COMPRESSION TEST FOR FILAMENT WOUND MATERIALS. REINFORCED PLASTICS FOR DEEP SUBMERGENCE AND OTHER HIGH STRENGTH APPLICATIONS

N. Fried and M. Silvergleit 28 May 1964 22 p refs

(PR-5; AD-602155)

The NASAL notched flat method for determining compressive strength of filament wound materials is described. Data are presented for a series of tests, in which a number of different methods of grip construction were employed, indicating good reproducibility, with an overall coefficient of variation of 4.9%. For a material of 2:1 orthogonal construction, with S glass reinforcement, an average compressive strength value of 157,800 psi was obtained in the stronger ("2") direction. This value is within 5% of the average value reported for tests on cylindrical specimens, of similar construction, tested hydrostatically. Very recent data for a material of superior quality, tested by the NASL notched flat method, gave an average value of compressive strength in the "2" direction of 178,000 psi, with an individual high of 192,800 psi. Based on these data, it is believed that laminates of this type may be produced with present day materials which will have compressive strengths of 200,000 psi or higher. Author

N65-27803# Du Pont de Nemours (E.I) and Co., Wilmington, Del. Engineering Materials Lab.

THE SLIDING OF PTFE ON PTFE Technical Documentary Report, Feb. 15–Aug. 15, 1964

R. P. Steijn Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1964 32 p refs

(Contract AF 33(615)-1201)

(ML-TDR-64-303; AD-610585)

In sliding tests, a weighted sled with PTFE runners was pulled over a PTFE track. The sliding velocity was measured as a function of tangential load and ambient temperature for two normal loads. The results have led to treating the sliding phenomenon as an activated viscous-flow process relating sliding speed to force of friction and absolute temperature. An activation energy of about 7 kcal/mole was found. The size of the kinetic unit was estimated. Electron microscopy was used to examine the sliding surfaces; very thin films of PTFE were extracted during replication. We hold shear in these films and their deformation responsible for the viscous sliding behavior. The effect of the crystalline transitions at 19° and 30° C was investigated. Time effects were noted throughout the entire test program and documented. Author

N65-27841# Rock Island Arsenal Lab., Ill. Lab. Branch.
EVALUATION OF ETHYLENE PROPYLENE TERPOLYMER ELASTOMERS
F. B. Testroet Mar. 1965 21 p refs
(RIA-65-618; AD-616322)

Commerical EPT elastomers were evaluated to ascertain their potential usefulness in military applications. It was found that EPT elastomers process easily and the resulting vulcanizates possess a unique combination of inherent qualities not available with other general purpose elastomers; i.e., low cost, good stress-strain properties, resistance to ozone attack and degradation caused by thermal oxidative processes coupled with excellent flexibility and resistance to embrittlement at temperatures of −55° F and −85° F respectively. Poor elastic recovery at low temperature is the most notable deficiency of these elastomers. Plasticizers produce an improvement in the good low temperature flexibility of EPT vulcanizates but fail to improve elastic recovery. Examples of high grade as well as highly extended, low cost compounds are presented. Author

N65-27852# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF ULTRAVIOLET RADIATION ON THE KINETICS OF CREEP AND DISINTEGRATION OF CAPRONE FIBERS
V. R. Regel' and N. N. Chernyy 27 Apr. 1965 15 p refs Transl. into ENGLISH from Vysokomol. Soyedineniya (USSR), v. 5, no. 6, 1963 p 925–931
(FTD-TT-64-1272/1+2; AD-616283)

The influence of ultraviolet radiation on deformation and disintegration in oriented caprone fibers was studied experimentally. These thin polymer strands were irradiated in different states of tension at 25° C. The radiation led to a sharp reduction in longevity of the fibers, while the rate of creep formation increased, though the product of the two remained practically constant. It is concluded that the change in the rate of the established creep in the oriented fibers is brought about by the change in the rate of the breakdown of the chemical bonds. J.M.D.

N65-27909# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REVIEW OF THE COLLECTION OF PROCEEDINGS ON THE SCIENTIFIC TECHNICAL CONFERENCE "ADDITIVES TO OILS AND FUELS"
Ye. S. Shepeleva and V. V. Sher 28 Jan. 1965 11 p Transl. into ENGLISH from Neftekhimiya (Moscow), v. 2, no. 3, 1962 p 420–423
(FTD-TT-64-779/1; AD-610648)

Studies on the synthesis of additives and on the mechanisms of additive actions, as they relate to petroleum technology, are briefly summarized. Among the research reviewed are reports on the application of different phosphorus-organic compounds as additives; the effect of synthesized additives on the oxidation of oil and hydrocarbon fractions of oil; the development of antiwear additives in the form of sulfurous compounds; the synthesis of polyglycol esters; the behavior of petroleum products under heavy systems of boundary friction; and the mechanisms of action of antioxidant and antiwear additives. M.G.J.

N65-27972# Midwest Research Inst., Kansas City, Mo.
SYNTHESIS OF ELASTOMERS CONTAINING Si-N BONDS IN THE MAIN CHAIN Final Technical Report, 29 Jun. 1961–28 Feb. 1965
L. W. Breed and R. L. Elliott 1 Apr. 1965 51 p refs
(Contract DA-23-072-ORD-1687)
(AD-614473)

Methods were sought for the synthesis of thermally and hydrolytically stable elastomers based on chains containing silicon atoms bonded directly to nitrogen. Classes of silazane polymers studied include condensed bis(amino-silyl)diazasilacyclopentanes, the products of the reaction of N-substituted cyclosilazanes and cyclosiloxazanes with organic diols, and polymers that can be derived from silylpiperazines, *p*-phenylenebis(alkylaminosilanes), and N-silylated-cyclosilazanes. High molecular weight condensation products of organic diols and N-substituted cyclosilazanes and siloxazanes with reasonably good hydrolytic stability and heat stability were obtained, but a satisfactory crosslinking procedure could not be found. Methods of synthesis and characterization of monomers are described, and structural modifications necessary to improve the hydrolytic stability of the silazane linkage are defined. sary to improve the hydrolytic stability of the silazane linkage are defined. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-26928# California Univ., Berkeley. Dept. of Mathematics.
THE LINEARIZATION OF SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS IN THE NEIGHBORHOOD OF A PERIODIC SURFACE OR INTEGRAL MANIFOLD
Al Kelley, Jr. Mar. 1965 19 p refs
(Contract Nonr-222(88))
(AD-615084)

The system of ordinary differential equations, $\dot{\theta} = a + H(\theta,x,y)$, $\dot{x} = Ax + X(\theta,x,y)$, $\dot{y} = By + Y(\theta,x,y)$, where all functions and arguments are vectors, is shown to be locally linear. In particular, for the neighborhood of a periodic solution, the author proves a theorem which asserts that by a regular change of variables these equations may be linearized when the original differential equation is continuously differential. This is a generalization of the results found in *On the Local Linearization of Differential Equations*, by P. Hartman, in *Proc. Amer. Math. Soc.*, 14 (1963). J.M.D.

N65-26940# Johann-Wolfgang-Goethe-Universitat, Frankfurt Am Main (West Germany). Mathematisches Seminar.
GROUP THEORY, GEOMETRICAL STRUCTURES, AND THEIR INTERRELATIONS Quarterly Technical Status Report, 1 Apr.–30 Jun. 1964
Reinhold Baer [1964] 7 p
(Contract DA-91-591-EUC-3180(W))
(QTSR-2; AD-461393)

In a series of brief mathematical reports, a theorem on automorphism in normal Hall subgroups, a definition of affine parallel structures for a Laguerre contact structure and its spear, a theorem on the imbedding of finite partial planes in a finite projective plane, an hypothesis on the solvability of a class of conjugate elements in a finite group, conditions under which a group is left commutator closed, and determination of all finite permutation groups with specified properties, are presented. J.M.D.

N65-27027# Joint Publications Research Service, Washington, D. C.
METHOD OF FINDING EXTREMUM SOLUTIONS TO A CLASS OF PROBLEMS
I. V. Serihiyenko 28 Jun. 1965 7 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 3, 1965 p296–299
(JPRS-30812; TT-65-31351) CFSTI: $1.00

A set of equations for finding solutions to a problem involving a group of differentiated objects is proposed. The solution is applied to the machining of tools to obtain optimum results for both quantity and quality. M.W.R.

N65-27040# California Univ., Berkeley. Operations Research Center.
AN INVENTORY MODEL FOR RENTED EQUIPMENT
William Whisler Dec. 1964 16 p refs Sponsored by the Forest Service
(ORC-64-21)

A study is made of the inventory problem of rented aircraft used in fighting forest fires. Assuming that all aircrafts in the inventory are rented, a description of the inventory model for the rented equipment is given. The costs associated with obtaining or returning of equipment and the rental costs are discussed. In addition to these costs, the costs associated with holding the inventory and the expected shortage costs are considered. The mathematical model is presented for a multiperiod problem. While the problem described specifically deals with an inventory of aircraft used in fighting forest fires the model is more general and can be used in other situations. N.E.A.

N65-27052*# Jet Propulsion Labs., Calif. Inst. of Tech., Pasadena.
TESTS OF HYPOTHESES AND ESTIMATION OF THE CORRELATION COEFFICIENT USING QUANTILES I
Isidore Eisenberger 1 Jun. 1965 65 p refs
(Contract NAS7-100)
(NASA-CR-63513; JPL-TR-32-718) CFSTI: HC $3.00/MF $0.75 CSCL 12A

This Report presents some of the results of the continuing investigation into the use of sample quantiles for data compression of space telemetry. The first two tests are concerned with the value of one of the parameters of a normal distribution when the value of the other is known. The third one tests both parameters simultaneously. The next two tests are two sample tests; one tests the hypothesis that $\mu_2 = \mu_1$, and the other tests the hypothesis that $\sigma_2 = \sigma_1$. Finally, pairs of sample values are tested for independence and, in addition, estimators of the correlation coefficient are given. The tests and estimators are all based on sample quantiles, and the sample sizes are assumed to be large. Author

N65-27058*# Stanford Univ., Calif. School of Humanities and Sciences
COMPUTATION OF THE PSEUDOINVERSE OF A MATRIX OF UNKNOWN RANK
Victor Pereyra and J. B. Rosen (Buenos Aires Univ.) 1 Sep. 1964 29 p refs
(Grant NsG-565)
(NASA-CR-63506; TR-CS-13) CFSTI: HC $2.00/MF $0.50 CSCL 12A

A program is described which computes the pseudoinverse, and other related quantities, of an m X n matrix A of unknown rank. The program obtains least square solutions to singular and/or inconsistent linear systems Ax = B, where $m \leq n$ or $m > n$ and the rank of A may be less than min(m,n). A complete description of the program and its use is given, including computational experience on a variety of problems. Author

N65-27100# Illinois Univ., Urbana. Coordinated Science Lab.
OPTIMUM CONTROL OF LINEAR SYSTEMS WITH TIME LAGS
Gurcharan Singh Tahim Jan. 1965 45 p refs
(Contracts DA-28-043-AMC-00073(E); AF 49(638)-1383)
(R-242; AD-610777)

The problem of optimal control of a system governed by linear differential–difference equations with constant coefficients was studied, and the necessary and sufficient conditions for complete controllability of such systems was established. For single input systems, the optimal control problem is related to the classical frequency domain problem of improving the sensitivity of the overall system with respect to parameter variations. In order to extend the relation between the optimization problem and the sensitivity improvement for multiple input systems, a sensitivity matrix is defined and its relationship with optimization is established. E.E.B.

N65-27116# California Univ., La Jolla. Computer Center.
AN INDEX OF APPROXIMATIONS OF FUNCTIONS, JANUARY 1952–MAY 1963
B. Prasad and V. L. Narasimham Feb. 1964 50 p refs With supplement
(Grant NSF GP-1413)
(UCSD-64-02)

A summary of the rational and polynomial approximations of mathematical functions that are used in scientific computations is presented. The approximations are grouped according to functions and the pertinent data are given, such as the limits of errors, range of independent variables, and the author's name with the year of publication. Numerical coefficients are listed only in the simple cases. This summary was developed as an adjunct for computer subroutines for the evaluation of special functions. G.G.

N65-27191# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
OPTIMAL COOPERATIVE STATE RENDEZVOUS AND PONTRYAGIN'S MAXIMUM PRINCIPLE
Stephen J. Kahne Apr. 1965 18 p refs *Its* Phys. and Mathematical Sci. Res. Papers No. 93
(AFCRL-65-233; AD-615110)

In the discussion of the theory of optimal cooperative rendezvous, it is shown that the problem of obtaining the optimal control of two independently controlled systems having a common goal may be solved using the Maximum Principle of Pontryagin. This will be accomplished provided certain special boundary conditions are obtained for the Hamiltonian system of differential equations. It is further demonstrated that the requirement that two state variables be equal at the rendezvous time implies that the adjoint variables associated

with them are negatives of each other at that time. Using this result, a first-order time-optimal rendezvous problem is solved and the results discussed. Indications for further work are also given. Author

N65-27207 France. Ministere de l'Air, Paris.
A METHOD OF NONLINEAR APPROXIMATION OF THE RESOLUTION OF EQUILIBRIUM LIMIT PROBLEMS OF COHERENT MEANS [UNE METHODE D'APPROXIMATION NON LINEAIRE DE RESOLUTION DES PROBLEMES D'EQUILIBRE LIMITE DES MILIEUX COHERENTS]
Eugeniusz Dembicki (Politechnika Gdanska) Serv. de Doc. Sci. et Tech. de l'Armement, 1965 155 p refs In FRENCH (NT-142)

A method of deriving approximate solutions to nonlinear hyperbolic partial differential equations, which determine the limiting plane of a heavy homogeneous medium that is subject to Coulomb's law, is presented in detail. The method is based on a Taylor series representation and is restricted to the third and fourth orders, which yields solutions of sufficient accuracy for engineering purposes. An application to the problem of determining the profile of the slope of a supporting substructure in a limiting state of equilibrium is included to illustrate the method. Trans. by J.M.D.

N65-27330# Yale Univ., New Haven, Conn.
SOME NOTIONS OF STABILITY AND RECURRENCE IN DYNAMICAL SYSTEMS
Joseph Auslander [1965] 12 p refs Presented at Polytech. Inst. of Brooklyn Symp. on System Theory, Brooklyn, 21 Apr. 1965
(Contract DA-31-124-ARO(D)165)
(AROD-4302-2; AD-464887)

Two families of sets, the prolongations and the prolongational limit sets of a point, are studied in the framework of a dynamical system on a locally compact separable metric space. These sets are useful in study of stability and recurrence and may be helpful in the classification of dynamical systems. Dynamical systems are first considered in the neighborhood of a singular point or a compact invariant set. It is proved that the conditions of parallelizability and dispersiveness imposed on a dynamical system are equivalent. It is also shown that in almost dispersive dynamical systems most prolongational limit sets are empty, and those which are not are long and thin. J.M.D.

N65-27408# Montana State Univ., Missoula. University Computer Center.
A NOTE ON VECTOR OPERATORS IN A NON-ORTHOGONAL COORDINATE SYSTEM Technical Report
R. P. Banaugh Jan. 1965 11 p refs
(TR-2)

Derivation of expressions for some well known differential operators when the derivatives of the function are known in specified directions, not necessarily mutually perpendicular. The directions are given by unit vectors which are prescribed with respect to a fixed frame. The results are probably not new, but neither the author nor his colleagues could readily locate them. Author

N65-27448# System Development Corp., Santa Monica, Calif.
A GRADIENT TECHNIQUE OF ADAPTIVE MONTE CARLO
E. L. Pugh 29 Jan. 1965 21 p refs
(SP-1921; AD-612943)

A technique of Monte Carlo estimation is presented which is "adaptive" in the sense that its efficiency increases as the sampling proceeds. It is based on sequentially estimating the gradient of the variance and following the path of steepest descent. The technique is applied to a problem of estimating the survival probability of a repairable machine. Author

N65-27449# Harvard Univ., Cambridge, Mass. Cruft Lab.
DIFFERENTIAL GAMES AND OPTIMAL PURSUIT-EVASION STRATEGIES
Yu-Chi Ho, A. E. Bryson, Jr., and S. Baron 4 Nov. 1964 8 p refs
(Contract Nonr-1866(16))
(TR-457; AD-609772)

In this report, we show that variational techniques can be applied to solve games with differential constraints. Conditions for capture and for optimality are derived for a class of optimal pursuit-evasion problems. Results are used to demonstrate that the well known "proportional navigation law" is actually an optimal intercept strategy. Author

N65-27465# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
ASYMPTOTIC COVARIANCES FOR THE MAXIMUM LIKELIHOOD ESTIMATORS OF THE PARAMETERS OF A NEGATIVE BINOMIAL DISTRIBUTION
K. O. Bowman and L. R. Shenton 1 Jul. 1965 153 p refs
(Contract W-7405-ENG-26)
(K-1643) CFSTI: $5.00

The parametric form considered for the Binomial Distribution has mean value kp and variance kp(1 + p), where k, p > 0. The first order covariances of $\hat{k}$, $\hat{p}$, the maximum likelihood estimators of k and p respectively, are given as elements in the inverse of the covariance matrix. These covariances are asymptotic expressions in the sample size n and are only valid in so-called large sample theory. To determine in a rough way how large n must be for the first order covariances to be approximately correct, the second order terms have been evaluated and tabulated. From these an indication of the sample size needed to place some confidence in the traditional asymptotic formulae is worked out. The results show that very large sample sizes may be required when k and p are both small. A similar study of another commonly used parametrization is given. The results have a bearing on the efficiency in joint estimation of the method of moments and this is discussed in some detail. Author

N65-27473*# Oak Ridge National Lab., Tenn. Neutron Physics Div.
UTILIZATION OF A PRIORI INFORMATION BY MEANS OF MATHEMATICAL PROGRAMMING IN THE STATISTICAL INTERPRETATION OF MEASURED DISTRIBUTIONS
W. R. Burrus (Ph.D. Thesis—Ohio State Univ.) Jun. 1965 115 p refs
(NASA Order R-104; Contract W-7405-ENG-26)
(NASA-CR-63442; ORNL-3743) CFSTI: HC $4.00/MF $0.75 CSCL 12A

A statistical approach is developed for unfolding instrument measurements which are related to an unknown function by a linear integral transportation. If statistical uncertainties are present in the measured function and in the kernel of the transformation, then the use of *a priori* information is shown to be necessary for a nontrivial solution. Without such information, an infinite-width confidence interval can be found for any nontrivial function of the unknown function. Suitable *a priori* information, however, nearly always exists in physically motivated problems. The weakest form of *a priori* information considered is simple nonnegativity. Stronger *a priori* information, such as smooth or monotonic behavior, can be put in the same form as simple nonnegativity by suitable transformation. The

unfolding problem requires two steps: selecting a set of functions of the unknown function to adequately describe the function and then numerically obtaining the width of the confidence interval for each function. Several computational techniques based upon linear and quadratic programming are described. Finally, the method is illustrated by unfolding gamma-ray and neutron spectra from pulse-height distributions obtained with scintillation spectrometers and by solving a poorly conditioned set of equations. Author

N65-27523# Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
A METHOD FOR COMPUTING THE INCOMPLETE BETA FUNCTION RATIO
A. R. DiDonato and M. P. Jarnagin, Jr. 28 Feb. 1965 61 p refs
(NWL-1949; AD-614568)

An efficient method is given for computing the incomplete beta function ratio, $I_x(a,b)$, on a high speed digital computer. The arguments a,b, are limited to positive integer or positive integral multiples of one-half values over the ranges $1/2 \leq a \leq 10^8$, $1/2 \leq b \leq 60$. I_x can be computed to at least 8 decimal digits. The program has been coded in STRAP for the IBM 7030 (STRETCH). The average computing time per case is 2.6 milliseconds; on an IBM 7090 it would be about 8 milliseconds per case. Author

N65-27577# RAND Corp., Santa Monica, Calif.
TWO NOTES ON ESTIMATING SHAPE PARAMETERS
Robert B. Wilson Apr. 1965 21 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4459-PR; AD-614419)

A new estimator for the shape parameter of a Weibull time-to-failure distribution is presented. The estimator maximizes the asymptotic form of the marginal likelihood function for the shape parameter. It is an easily tabulated univariate function of the ratio of the geometric and arithmetic means of the sample data, but because of its dependency upon an asymptotic approximation, its usefulness is confined mostly to large sample applications. New estimators for the shape parameter of a gamma distribution are also presented. The marginal likelihood function for the shape parameter of a gamma distribution is obtained, and from this the maximum marginal-likelihood estimator is found in terms of tabulated functions. The estimator is tabulated for various sample sizes as a function of the ratio of the geometric and arithmetic means of the sample data. An approximation to the marginal distribution of the shape parameter is derived and simpler approximate formulae obtained for the Bayes and maximum-likelihood estimators. R.N.A.

N65-27705*# National Aeronautics and Space Administration, Washington, D. C.
PERTURBATION OF THE SOLUTIONS OF A SECOND ORDER DIFFERENTIAL EQUATION WITH PERTURBATION OF THE BOUNDARY [VOSMUSHCHENIYE RESHENIY DIFFERENTSIAL'NOGO URAVNENIYA VTOROGO PORYADKA PRI VOZMUSHCHENII GRANITSY]
Tsung-ch'ih Lin Jun. 1965 11 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. (Moscow), no. 6, 1964 p 17–23
(NASA-TT-F-9409) CFSTI: HC $1.00/MF $0.50 CSCL 12A

This paper is concerned with the perturbation introduced into the solutions of a second order differential equation when the boundary is perturbed. The solution of the perturbed problem is expanded in a series in ϵ. The convergence of the series is proved for $|\epsilon| < 1/R$ (Where $R > 0$ is a constant). Author

N65-27722*# National Aeronautics and Space Administration, Washington, D. C.
A RANDOM ITERATION PROCESS [SLUCHAYNYY ITERATSIONNYY PROTSESS]
Yu. V. Vorob'yev Jul. 1965 11 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, no. 6, Nov.–Dec. 1964 p 1088–1093
(NASA-TT-F-9443) CFSTI: HC $1.00/MF $0.50 CSCL 12A

A method of solving the problem $Ax = f$, where A is a linear operator, using random iteration processes is given. Author

N65-27757# RAND Corp., Santa Monica, Calif.
A NOTE ON THE IDENTIFICATION OF LINEAR SYSTEMS
Richard Bellman Feb. 1965 10 p refs
(Contract AF 49(638)-700)
(RM-4412-PR; AD-610636)

We consider the problem of ascertaining when the conditions

$$\int_0^T u(t)\phi_j(t)dt = b_j,\ j = 1,2,\ldots,N.$$

determine a unique solution of

$$u^{(N)} + a_1(t)u^{(N-1)} + \ldots + a_N(t)u = 0.$$

This is a particular problem arising in the general study of the identification of linear systems. Author

N65-27761# RAND Corp., Santa Monica, Calif.
PROJECTIVE METRICS IN DYNAMIC PROGRAMMING
Richard Bellman and Thomas A. Brown Jan. 1965 7 p refs
(AD-610581)

A projective metric, similar to Hilbert's which has been used with problems involved in linear mappings, may be applied to some nonlinear mappings which frequently arise in dynamic programming. The metric and functions are defined; and a theorem about ratio reducing is offered and its application to programming is illustrated with the proof of another theorem. M.W.R.

N65-27762# RAND Corp., Santa Monica, Calif.
TRANSVERSAL PACKINGS AND COVERS
D. R. Fulkerson Feb. 1965 23 p refs
(Contract AF 49(638)-700)
(RM-4411-PR; AD-610556)

Two combinatorial problems involving partial transversals of a collection of subsets of a finite set are considered. The problem of constructing a transversal packing can be formulated in terms of flows in networks and existence conditions obtained from results in network flow theory. A similar approach is presented for an analogous covering problem involving partial transversals of prescribed sizes. The packing problem for partial problems of prescribed sizes can be posed in terms of maximal flow from source to sink in a suitable directed network having capacity constraints on arcs. A proof is given which indicates that a good algorithm is available for constructing a packing of transversals, since the labeling method for constructing maximal flows in network applies. Maximum packings and minimum covers are prescribed by corollaries to theorems described, and these are related to matroid theory. M.W.R.

N65-27795# Technion Research and Development Foundation, Ltd., Haifa (Israel). Dept. of Mechanics.
THE PHYSICAL TENSOR AND APPLICATION Final Scientific Report

Z. Karni 4 Oct. 1964 53 p refs
(Grant AF-EOAR-63-72)
(AD-610566)

The physical tensor as a multilinear vector form, resolution with respect to oblique coordinate networks, invariancy under resolution, general derivative, and curvilinear derivative is given. Curvature tensors of degree m are introduced. The construction of tensor and generalized differential invariants and their application as integrity bases for some types of singular and quasi-singular multilinear vector forms are discussed. Author

N65-27854# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON METHODS OF ECONOMIZING THE MEMORIES OF DIGITAL COMPUTERS WHEN SOLVING DIFFERENTIAL EQUATION SYSTEMS
I. N. Molchanov 13 May 1965 21 p refs Transl. into ENGLISH from Sibirskiy Mat. Zhur. (Novosibirsk), v. 5, no. 1, 1964 p 109–123
(FTD-TT-65-34/1+2; AD-616309)

Methods of solving boundary problems for two- and three-dimensional self-conjugated differential equations of elliptical type in an arbitrary grid zone are discussed. Simple iteration-type methods are proposed. The convergence of formulated iteration processes and the theoretical rate of convergence for the "single-line" method are considered. M.W.R.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-26797# Joint Publications Research Service, Washington, D. C.
THE SOVIET WEATHER SERVICE AND NEW METEOROLOGICAL TECHNIQUES
A. V. Kunits and M. V. Matveyev 16 Jun. 1965 40 p Transl. into ENGLISH of chapters 12 and 13 of the book "Sinopticheskaya Meteorologia" Leningrad, State Publishing House for Hydrometeorol. Lit., 1964 p 280–313
(JPRS-30636; TT-65-31272) CFSTI: $2.00

CONTENTS:

1. METEOROLOGICAL SERVICING OF THE NATIONAL ECONOMY A. V. Kunits and M. V. Matveyev p 1–25 (See N65-26798 16-20)

2. NEW TECHNICAL MEANS IN SYNOPTIC METEOROLOGY A. V. Kunits and M. V. Matveyev p 26–40 (See N65-26799 16-20)

N65-26798 Joint Publications Research Service, Washington, D. C.
METEOROLOGICAL SERVICING OF THE NATIONAL ECONOMY
A. V. Kunits and M. V. Matveyev *In its* Soviet Weather Serv. and New Meteorol. Tech. 16 Jun. 1965 p 1–25 (See N65-26797 16-20) CFSTI: $2.00

The objectives, organization, types of weather information, and the various consumers of the Soviet weather service are described. The weather service provides organizations concerned with the national economy with weather information necessary for planning production and everyday practical use in current activity, and timely warnings of anticipated dangerous weather phenomena. Meteorological information is divided into regular reports transmitted at scheduled times, urgent reports on the development of a dangerous weather phenomenon, sporadic reports for the specific requirements of an organization, and special snowstorm warnings for the railways. Weather service is provided to air, railroad, highway, and sea transportation organizations, to the fishing and river fleets, and to the electric power stations. R.N.A.

N65-26799 Joint Publications Research Service, Washington, D. C.
NEW TECHNICAL MEANS IN SYNOPTIC METEOROLOGY
A. V. Kunits and M. V. Matveyev *In its* Soviet Weather Serv. and New Meteorol. Tech. 16 Jun. 1965 p 26–40 (See N65-26797 16-20) CFSTI: $2.00

New techniques being used and developed in synoptic meteorology are described. Automatic meteorological stations broaden the possibilities of collecting weather dat: They automatically measure atmospheric pressure, air tem perature, dew point spread, precipitation quantity and intensity, duration of solar radiation, wind velocity and direction, and horizontal visibility. Artificial meteorological satellites, electronic computers, and aircraft weather reconnaissance offer even greater possibilities for meteorological data collection. Aircraft measurements are more extensive and more complete because they are made continuously during a flight. Satellites can make observations of cloud cover, determine the height of the upper cloud boundary, investigate the radiation balance of the Earth, study the composition of the atmosphere and vertical temperature distribution, and investigate precipitation, wind, and the underlying surface. Computers can forecast events by deriving a closed system of equations which describe the laws of atmospheric processes and developing methods for solving them. R.N.A.

N65-26912# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 188
21 Jun. 1965 48 p refs Transl. into ENGLISH from Ch I Hsiang Hsueh Pao (Peiping), v. 35, no. 1, 26 Feb. 1965 p 18–32, 75–81
(JPRS-30705; TT-65-31293) CFSTI: $2.00

CONTENTS:

1. NUMERICAL ANALYSIS OF THE PROCESS OF SHEAR LINE FORMATION OVER THE YANGTSE AND HUAI RIVERS Li-jen Chi p 1–34 refs

2. A NUMERICAL TEST USING PRIMITIVE BAROTROPIC EQUATION Jui-chih Liu and Chi-peng Chang p 35–45 refs (See N65-26913 16-20)

N65-26913 Joint Publications Research Service, Washington, D. C.
A NUMERICAL TEST USING PRIMITIVE BAROTROPIC EQUATION
Jui-chih Liu and Chi-peng Chang *In its* Transl. on Communist China's Sci. and Technol., no. 188 21 Jun. 1965 p 35–45 refs (See N65-26912 16-20) CFSTI: $2.00

A preliminary test of numerical forecasts for the Northern Hemisphere using primitive barotropic equations is outlined. The finite difference scheme for centered differences in time and space is employed, and initial and boundary conditions

are determined. The resultant data were found to be satisfactory in making four 24-hour weather forecasts, and it was considered as good or better than data obtained with a geostrophic model. Limitations to the barotropic method, it was pointed out, are (1) the grid interval employed is too large; and (2) the fixed boundary conditions are not always satisfactory because the finite difference with respect to time is rather short in the primitive equation. M.W.R.

N65-26952# Inter-Range Instrumentation Group, White Sands Missile Range, N. Mex.
METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME XXXVIII: OCTOBER 1964 FIRINGS Data Report Apr. 1965 296 p
(IRIG-109-62; AD-464530)

Wind and temperature measurements from all available network firings for October 1964 are included. Radiosonde observations nearest the times of successful firings, provided they are within ±6 hours, are also included. A complete description of the data, which derived from 135 rocketsonde observations, is included. Charts and graphs of the meteorological sounding data for each of the observations are presented. M.W.R.

N65-27200# Illionis State Water Survey, Urbana. Meteorologic Lab.
INVESTIGATION OF THE QUANTITATIVE DETERMINATION OF POINT AND AREAL PRECIPITATION BY RADAR ECHO MEASUREMENTS Final Report, 1 Oct. 1961–30 Sep. 1964
A. L. Sims, E. A. Mueller, G. E. Stout, and William C. Ackermann [1964] 58 p refs
(Contract DA-36-039-SC-87280)
(AD-615772)

During the period of this contract, a raindrop camera was operated at Island Beach, New Jersey; Coweeta Hydrologic Laboratory, North Carolina; East Central Illinois raingage network; and for summer operation only at Mt. Withington, New Mexico, and Flagstaff, Arizona. The data obtained have been measured and preliminary calculations have been made. The results of analysis of the relationships between rainfall rate and radar reflectivity are reported along with recommendations as to the appropriate relationship to be used under given conditions at various climatic regions. At a location such as Miami, Florida, a relationship determined by the thermodynamic instability is recommended. A single relationship is recommended for Majuro and Oregon where so far no stratification has made significant improvement. Author

N65-27311# Stanford Research Inst., Menlo Park, Calif.
STUDIES OF DAYTIME RADIATION FROM TIROS Final Report, 1 Apr. 1963–1 Feb. 1965
William Viezee and Paul A. Davis Feb. 1965 32 p refs
(Contract AF 19(628)-2777)
(AFCRL-65-160; AD-614927)

Analysis of a sample of wintertime data from TIROS IV over the United States shows that snow cover and a low-level temperature inversion tend to mask the relationship between cloudiness and Channel 2 (8–12 microns) temperature. However, both Channel 3 (0.2–6.0 microns) and Channel 5 (0.55–0.75 micron) describe the cloudiness well. For areas with overcast stratiform cloudiness data from the solar channels of TIROS III and IV are compared with reports of cloud-ceiling height. High clouds and low-based clouds can be readily distinguished from the radiation data on the basis of low and high albedos, respectively. However, no distinct relation between albedo and ceiling height is evident for the intermediate range of albedos (40 to 60 percent for Channel 5 and 30 to 50 percent for Channel 3). Variations in the solar reflectance measurements with changes in the viewing geometry could not be determined from a sample of closed-mode data because of apparent errors in rectification. Author

N65-27422# Texas A&M Univ., College Station. Dept. of Oceanography and Meteorology.
A COMPARISON OF RAIN GAGE AND DUAL-FREQUENCY RADAR DATA OF PRECIPITATION
John A. Owens, Jr. (M.S. Thesis) May 1965 75 p refs Sponsored by AF
(AD-615095)

The standard technique used to determine rainfall quantity and intensity is by use of a rain gage. This procedure is slow, expensive, and nearly impossible over certain types of terrain, e.g., mountainous and water areas. A dual-frequency radar system of 3.2-cm and 10.3-cm wave lengths was used to measure the reflectivity of a storm cell. The relationship between radar reflectivity, Z, and rainfall rate, R, permits computation of R when Z is measured. In this study, correlation coefficients were computed between measured R and observed Z. The radar pattern is fitted to the actual rainfall intensity pattern. This method, at present, does not lend itself to quantitative measurement of rainfall intensity; however, reliable estimates of the rainfall distribution are possible. Author

N65-27428# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS FROM METEOROLOGIYA I GIDROLOGIYA (METEOROLOGY AND HYDROLOGY), NO. 5, 1965
17 Jun. 1965 115 p refs Transl. into ENGLISH of 15 articles from Meteorol. i Gidrol (Moscow), no. 5, May 1965 p 3–6, 14–52, 56–68
(JPRS-30658; TT-65-31282) CFSTI: $4.00

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7. SOME PROBLEMS IN THE PRACTICE OF INSTRUMENTAL MEASUREMENTS OF THE HEIGHT OF THE LOWER CLOUD BOUNDARY N. S. Bozhevikov p 69–74 refs (See N65-27435 16-20)

N65-27429 Joint Publications Research Service, Washington, D. C.
USE OF THE PRINCIPLE OF CONSTRUCTING SURFACE CHARTS FOR THE NUMERICAL ANALYSIS OF AEROLOGICAL DATA

V. V. Bykov and O. K. Gorbunova *In its* Transl. from Meteorol. i Gidrol. (Meteorology and Hydrol.), no. 5, 1965 p 6–18 refs (See N65-27428 16-20) CFSTI: $4.00

A mathematical model for multilevel analysis of aerological data for a limited geographical area is presented. This least-squares technique for numerical analysis, based on the principle of construction of pressure pattern charts, makes extensive use of polynomial approximation of meteorological fields. A computer program was composed to carry out the calculations, and it was used in compiling day-to-day short range forecasts. Quality of the forecasts derived by numerical analysis is approximately the same as that obtained in synoptic analysis. J.M.D.

N65-27430 Joint Publications Research Service, Washington, D. C.

EXPERIENCE IN CONSTRUCTING A SYNOPTIC-STATISTICAL METHOD FOR TEN-DAY TEMPERATURE ANOMALY FORECASTING

A. L. Kats *In its* Transl. from Meteorol. i Gidrol. (Meteorology and Hydrol.), no. 5, 1965 p 19–26 refs (See N65-27428 16-20) CFSTI: $4.00

A statistical method for predicting 10-day temperature anomalies is presented. In this method, the predicted temperature anomaly value is expressed as a linear function of the intensity of zonal and meridional circulation, and of the initial temperature anomaly at that station. Estimates of the constants in this equation were derived by the least-squares procedure, using data from 228 10-day periods. These derived values were then compared with the success of standard 10-day inertia forecasts for data on 50 additional 10-day periods: in 62% of these cases the statistical forecasts were better than the inertia forecasts, the same in 20%, and worse than the inertia results in 18%. J.M.D.

N65-27431 Joint Publications Research Service, Washington, D. C.

THE BANK STRUCTURE OF THE CLOUD COVER

V. A. Bugayev *In its* Transl. from Meteorol. i Gidrol. (Meteorology and Hydrol.), no. 5, 1965 p 27–39 refs (See N65-27428 16-20) CFSTI: $4.00

Weather charts, satellite data, and flight observations are discussed concerning the formation of cloud covers and the structure of cloud banks. J.M.D.

N65-27432 Joint Publications Research Service, Washington, D. C.

THE RADAR METHOD FOR DETERMINING LIQUID PRECIPITATION AND HAIL

V. F. Lapcheva and G. K. Sulakvelidze *In its* Transl. from Meteorol. i Gidrol. (Meteorology and Hydrol.), no. 5, 1965 p 40–49 refs (See N65-27428 16-20) CFSTI: $4.00

A radar method is described for determination of the form of precipitation falling from convective clouds. A relationship between the form of precipitation and the value of radar reflectivity from the cloud was derived from observations made in a high mountain area. In particular, the size of hail particles in the cloud is determined from the value of the radar reflectivity. Application of this method revealed that about 80% of the liquid shower during the summer in the foothills of the Northern Caucasus falls from clouds in which hail with a diameter less than 2.0 cm is formed, and that the particles melt while dropping and reach the earth surface as rain. J.M.D.

N65-27433 Joint Publications Research Service, Washington, D. C.

CALCULATION OF WATER VAPOR TRANSPORT IN THE ATMOSPHERE

L. S. Yevseyeva and V. F. Yevseyev *In its* Transl. from Meteorol. i Gidrol. (Meteorology and Hydrol.), no. 5, 1965 p 50–59 refs (See N65-27428 16-20) CFSTI: $4.00

Computations of the horizontal fluxes of water vapor and the moisture balance in the atmosphere for January and July 1959 over the Caspian Sea are reported. By means of a comparison of the results of moisture transport and measured precipitation, it was found that the difference between the outgoing and incoming moisture was 27 mm in January; in July that value was 105 mm, meaning in both cases that there was an enrichment of the atmosphere with moisture. J.M.D.

N65-27434 Joint Publications Research Service, Washington, D. C.

THE PROBLEM OF THE INFLUENCE OF FORCED ASCENT OF AIR ON THE VERTICAL STABILITY OF THE ATMOSPHERE

Sh. I. Tsitsvashvili *In its* Transl. from Meteorol. i Gidrol. (Meteorology and Hydrol.), no. 5, 1965 p 60–68 refs (See N65-27428 16-20) CFSTI: $4.00

The effect of forced ascent of air on vertical atmospheric instability is studied theoretically. Forced ascent of air occurs at the surface of active cold fronts and when an air mass flows onto a mountain. From a set of differential equations which describes thermodynamic properties of this phenomenon, an expression for temperature gradient is derived. Analysis of this temperature gradient, and its dependence on various factors, suggests that the vertical velocities generated by forced ascent cause a substantial change in stratification toward the formation of instability, and thus creates favorable conditions for the development of convective clouds and the thunderstorm-hail phenomena associated with them. J.M.D.

N65-27435 Joint Publications Research Service, Washington, D. C.

SOME PROBLEMS IN THE PRACTICE OF INSTRUMENTAL MEASUREMENTS OF THE HEIGHT OF THE LOWER CLOUD BOUNDARY

N. S. Bozhevikov *In its* Transl. from Meteorol. i Gidrol. (Meteorology and Hydrol.), no. 5, 1965 p 69–74 refs (See N65-27428 16-20) CFSTI: $4.00

Several instrumental techniques for determining the height of the lower cloud boundary at airports were compared in actual use. The instruments were a pulsed-light range finder, a recorder, and a pilot balloon; observation from aircraft was included. All instruments, apparatus, and methods were found to be encumbered with systematic errors. Certain refinements in the techniques are described which improve height determination. It is concluded that measurement of the height of the lower boundary of clouds up to 200 m should be made either with pulsed-light range finders or recorders, but for clouds above 250 m readings by all methods agree satisfactorily with one another. J.M.D.

N65-27640*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE INFRARED INTERFEROMETER SPECTROMETER EXPERIMENT (IRIS). VOLUME II: METEOROLOGICAL MISSION

R. A. Hanel and L. Chaney (Michigan Univ.) Feb. 1965 46 p refs

(NASA-TM-X-55218; X 650-65-75) CFSTI: HC $2.00/MF $0.50 CSCL 04A

The goals of the IRIS Experiment are the measurement of parameters describing the vertical structure of the atmosphere such as temperature, humidity and cloud height. This

information is extracted from the thermal emission spectral between 5 and 20μ. A Michelson type interferometer capable of resolving to 5 cm^{-1} is described in detail. Author

N65-27648# Weather Services, Inc., Boston, Mass.
TECHNIQUES OF DATA REDUCTION FOR GROUND BASED STEREO PHOTOGRAPHS AND AIRCRAFT RECORDED ATMOSPHERIC VARIABLES Final Report, 14 Dec. 1959–31 Dec. 1964
Carol J. Greenough 31 Mar. 1965 90 p refs
(Contract AF 19(604)-6616)
(AFCRL-65-262; AD-615426)

Data was reduced and analyzed to support studies on the growth and dynamics of cumulus clouds. The photographs and record charts evaluated were supplied by the Cloud Physics Branch, Meteorology Laboratory, Air Force Cambridge Research Laboratory. Measurement techniques introduced and used to obtain a sequence of measurements for cumulus clouds from stereo ground based photographs. Trajectories, dimensions, and velocities of cloud tufts were obtained from computer processing and graphed. Atmospheric variables and electric fields patterns were determined from oscillograph records of instruments aboard aircraft. Author

N65-27721*# National Aeronautics and Space Administration, Washington, D. C.
MEASURING THE SPECTRUM OF CLOUD DROPLETS [OB IZMERENII SPEKTRA OBLACHNYKH KAPEL]
V. Ye. Minervin and G. T. Nikandrova Jul. 1965 20 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 55, 1964 p 18–31
(NASA-TT-F-9441) CFSTI: HC $1.00/MF $0.50 CSCL 03B

A brief review is given of the methods used in measuring the spectrum of cloud droplets. Data are presented on the simultaneous measurement of droplet spectra in a stream using devices with different capture coefficients. Experimental results fail to confirm the correctness of the theoretical factors for droplet capture obtained earlier for the instruments. Author

N65-27772# United Air Lines, Inc., Chicago, Ill. Weather Research Staff
UAL EXPOSURE TO SUPERCOOLED FOG
Henry T. Harrison 1 May 1965 164 p *Its* Meteorology Circ. No. 58

A survey of supercooled fog conditions at the airports of a commercial airline system, is reported. For each airport a table is given listing data on the number of hours of frequency of subminimum supercooled fog at the airport over the span of years 1955–1964; and a separate listing of the time for mean annual frequency of subminimum supercooled fog at the airports is also listed. In addition, temperature and wind data from air samples are recorded. The highest incidence of supercooled fog is found at inland valley airports in the Pacific Northwest. One tendency in the data which should be helpful to forecasters, planners, and seeders is evidence that fogs which become well established at temperatures above 32° F seldom become supercooled later on in the night. There are at least 25 airports in the airline system where local city governments should give careful consideration to the advisability of setting up standby seeding arrangements. L.S.

N65-27778# Travelers Research Center, Inc., Hartford, Conn.
INITIAL IMPLEMENTATION TESTS OF WEATHER SUPPORT TO THE NATIONAL AIRSPACE SYSTEM Final Report, Jul. 1963–Aug. 1964
Lawrence J. Reed Dec. 1964 201 p refs *Its* Rept.-7663-134
Contract FA-WA-4644)
(RD-64-147; AD-611816)

The initial phases of a quasi-real-time test of computer programs employing modern weather techniques under operational conditions which focused on estimating the feasibility, meteorological accuracy, and timeliness were examined. Analysis and forecast were prepared from live data. Two meteorological techniques were tested: (1) a statistical method for predicting ceiling and visibility up to seven hours, and (2) an analysis method based on elements reported from ground stations, e.g., ceiling, visibility, pressure, temperature, dew point, wind speed, and precipitation. R.W.H.

N65-27839# Stanford Research Inst., Menlo Park, Calif.
DISTRIBUTIONS AND CHARACTERISTICS OF VARIOUS BROADSCALE AND SPECIAL CLOUD SYSTEMS Final Report, 7 Nov. 1962–31 Jan. 1965
Roy H. Blackmer, Jr. and John E. Alder Apr. 1965 105 p refs
(Contract AF 19(628)-1681)
(AFCRL-65-211; AD-616295)

Cloud cover—as shown by various types of data such as surface observations, satellite photographs, U-2 photographs, and vertically pointing radar—was analyzed to provide information on clouds as an obstacle to vision through the atmosphere. In these studies the photographic data were used to assess the extent to which significant operational knowledge can be derived from surface cloud observations. Comparison of surface observations with U-2 and TIROS photographs shows that surface observations are frequently not representative of cloud cover over even a small fraction of the distance between adjacent stations. Time changes in cloud cover were determined from hourly cloud observations and were summarized to show the probability of extended periods of various amounts of cloud cover. Comparison of probabilities for different seasons and different geographic locations is included. The probabilities of seeing specific locations along latitudes 15, 30, and 45° N were determined from nephanalyses of TIROS photographs and surface synoptic reports. These probabilities are given for the four seasons, and the effects of synoptic features on these probabilities are discussed. The report also contains cloud top altitudes measured from U-2 photographs and thicknesses of cloud layers with bases at various heights as shown by a vertically pointing radar. Author

N65-27840# Aracon Geophysics Co., Concord, Mass.
OPERATIONAL USE OF TIROS RADIATION MEASUREMENTS Final Report, 16 Mar. 1964–15 Mar. 1965
Paul E. Sherr and Raymond Wexler Apr. 1965 61 p refs *Its* Rept.-9G5-4
(Contract AF 19(628)-4074)
(AFCRL-65-193; AD-616351)

TIROS radiation data are shown to be of significant operational value if they can be made available in real-time. Channel 2 radiation analyses at a 1:20 or a 1:10 million map scale clearly reveal cloud patterns which correlate well with synoptic systems. Use of a larger scale map (1:5 million) enables detail at the smaller synoptic (or cyclonic) scale to be observed. The integrated analysis of photographic and radiation analyses provide advantages which include better picture interpretation and some insights into the character and growth stage of cyclonic disturbances. Channel 3 (visible) data can be used as a fair substitute for the pictures. TIROS photographs of a thunderstorm complex over Florida reveal certain mesoscale features such as the anvil, a line of cumulus associated with the sea breeze. Channel 2 measurements indicate that

echo tops are higher over the anvil in the Gulf but radar measurements show that the more active storms over the Florida peninsula are higher. The apparent discrepancy is resolved by considering the field of view of the radiometer. Author

N65-27873# Freie Univ., Berlin (West Germany). Institut für Meteorologie und Geophysik.
DAILY AND MONTHLY NORTHERN HEMISPHERE 30-MILLIBAR SYNOPTIC WEATHER MAPS OF THE YEAR 1964, PART IV: OCTOBER–DECEMBER Quarterly Technical Status Report
Barbara Kriester, Karin Labitzke, Richard Scherhag, and Renate Stuhrmann Dietrich Reimer, 1965 108 p *Its* Meteorol. Abhandl., Vol. 48, No. 4
(Contract DA-91-591-EUC-3288)
(QTSR-4; AD-464916)

These reports are published quarterly and present 30 mb maps, day by day, throughout 1964. Height and temperature data are plotted on each chart and appropriate contours are drawn. A discussion of the stratospheric circulation for each quarter is included. Each volume also contains mean monthly maps and charts of changes in the means from month to month, for the appropriate months. Author

N65-27880# McGill Univ., Montreal (Quebec). Arctic Meteorology Research Group.
SOME ASPECTS OF THE MIDDLE STRATOSPHERE Final Report, Mar. 1961–Feb. 1965
B. W. Boville Mar. 1965 38 p refs *Its* Publ. in Meteorology No. 75
(Contract AF 19(604)-8431)
(AFCRL-65-187; AD-616253)

The mean pressure patterns in the middle stratosphere and the latitudinal distribution of total ozone are presented for both hemispheres. It is then inferred that the major stratospheric warmings are probably associated with nonlinear baroclinic interaction between troposphere and stratosphere. The major difficulties in resolving the problem arise from the absence of vertical motion measurements and our present inability to model effectively on the planetary scale. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-26795 Naval Research Lab., Washington, D. C. Applications Research Div.
THE RAINBOW OPTICAL LANDING AID
Barbour Lee Perry *In its* Rept. of NRL Progr. Apr. 1965 p 1–10 refs (See N65-26794 16-34)

The Navy is conducting a program to increase the safety of landing high-performance aircraft aboard carriers, particularly in nighttime operations. A mathematical analysis conducted at the U.S. Naval Research Laboratory has pinpointed two prime sources of system inaccuracies in the use of the current displays. These are insufficient display gain and the absence of any derivative, or lead, signals in the displayed error indication which were shown analytically to be required for acceptable man-machine system stability and response. The Rainbow Optical Landing Aid has been designed at NRL to provide such lead, at high gain, by means of a color-sequence-coded signal. It is an optical-geometrical system which requires neither mechanical nor electronic sensing of flight parameters. A red-white-blue sequence on the indicator tells the pilot to increase his sink rate; a blue-white-red sequence indicates that a smaller sink rate is required; and a steady green signal informs the pilot that he is maintaining an approach within ±0.1 degree of glide path. Any steady color other than green indicates that he is not within the ±0.1 degree envelope but is controlling his sink rate so as to approach the glide path exponentially. In preliminary tests, the Rainbow Optical Landing Aid has been used in bright sunlight at ranges as great as 3.5 miles and in nighttime at ranges as great as 15 miles. Author

N65-27305# Naval Ordnance Test Station, China Lake, Calif. Weapons Development Dept.
PDM TELEMETRY SETS FOR SIDEWINDER
Thomas Wong, R. L. Thomason, and Gary Davis Feb. 1965 47 p refs
(NAVWEPS-8627; NOTS-TP-3658; AD-615750)

The description of the development of the telemetry systems used in the testing of the Sidewinder missile from 1952 to 1960 is reported herein. The six basic telemetering systems developed during this time, including the Type 6 unit used with Sidewinder 1C, are described. Details of the Type 5 telemetering unit used with Sidewinder 1A is provided in Appendix A. The data reduction methods used with these units are described in Appendix B. Author

N65-27358# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
TOMORROW'S FISSION REACTOR AND ITS MATERIALS DEMANDS
W. B. Lewis Feb. 1964 20 p refs Presented at the ASTM Conf., Philadelphia, 3–6 Feb. 1964
(DL-56; AECL-2236)

Good neutron economy, high thermal efficiency and long life will be demanded for economic operation of nuclear power reactors. The neutron economic penalty for stainless steel within the reactor amounts typically to $300/yr per kilogram and for zirconium to $15/yr per kilogram. High thermal efficiency demands high temperatures that set limits on life. Basic problems are set by the permeability of all solids at high temperatures to their own and to foreign atoms. Fortunately, radiation damage tends to anneal out at high temperatures because of this atomic mobility. Unfortunately, interaction between the heat transport fluid and its confining boundaries, coupled with the economic penalty of allowing any release of radioactive fission products, sets problems still unsolved and for which even basic scientific understanding remains to be developed. Tests of corrosion, stress-rupture, creep, delayed failure and fatigue under operating conditions measure the degree of success in achieving long term stability but give only meager hints of the internal processes we seek to control. Nevertheless, by applying ignorance factors to act as "safety" factors, large reactors of economic promise can already be engineered. Further research and testing hold great promise of scientific satisfaction and economic reward. Author

N65-27845*# Pennsylvania Univ., Philadelphia. Moore School of Engineering.
GIMBALLESS INERTIAL NAVIGATION SYSTEMS Semi-annual Progress Report, 1 Nov. 1964–30 Apr. 1965

Kenneth A. Fegley May 1965 119 p refs *Its* Rept. 65-26 (Grant NGR-39-010-029)
(NASA-CR-63474) CFSTI: HC $4.00/MF $0.75 CSCL 17G

Studies are continuing on gimballess inertial navigation systems. Accelerometers can sense angular velocity in an inertial navigation system by using six or more fixed to the vehicle or by mounting one on each of two perpendicular rotating rings. The use of eight or more accelerometers avoids ambiguity and allows greater freedom in their placement. Linear and angular acceleration can be determined even though the accelerometers are not placed symmetrically about the vehicle's center of mass and even though the center of mass moves due to fuel consumption. Three methods of stabilizing the mechanization of the navigation equations for gimballess navigation systems are being studied and include damping by means of reference trajectory information, damping by means of external velocity information, and elimination of diverging errors by means of altimeter information. A rotating disk mounted on a dividing head and carrying an accelerometer is under construction for rotating accelerometer experimental studies. Plans are being made to simulate a navigation system on a digitial computer. R.N.A.

N65-27674*# Northrop Space Labs., Huntsville, Ala. Space Systems Section.
APOLLO EXTENSION SYSTEM PAYLOADS. SIMPLIFIED GUIDANCE AND NAVIGATION SYSTEM FOR LUNAR FLYING VEHICLE
A. V. Cohee, F. A. Clark, D. F. Mc Allister, and A. J. Taylor May 1965 60 p refs
(Contract NAS8-20082)
(NASA-CR-61057) CFSTI: HC $3.00/MF $0.50 CSCL 17G

The manual control aspects of a lunar flying vehicle and the environmental factors which affect system selection are discussed. Factors, such as the harsh lighting of the lunar surface coupled with height and distance distortion due to the size of the moon, are analyzed to determine if a manual system represents an improvement over a fully automatic system. A typical flight is simulated using an IBM computer program in order to determine the reserve fuel remaining at the target as a function of the mission profiles. It is concluded that for a 1100 ft altitude and a velocity of 900 ft/sec the mission profile will require 497 lbs for a 421 sec flight. The requirement for maneuvering at the terminal end of the flight is discussed and a simple radio frequency beacon is recommended due to limited time available at the terminus of the flight and to the large area of surveillance that the pilot must scan. Also, a system functional analysis is presented for each phase of the mission from liftoff, ascent, and vehicle alignment, to descent. E.E.B.

N65-27733# Advisory Group for Aeronautical Research and Development, Paris (France).
TESTING OF DOPPLER PHI SYSTEMS
H. Faber (Flight Test Center, Oberpfaffenhofen (W. Germany) Oct. 1964 11 p
(AGARD-495)

The report describes the components, testing and results of a navigational system installed in the Fiat G-91 fighter-reconnaissance aircraft. There are three main components—the doppler radar, the compass and the position homing indicator (PHI)—and an auxiliary device computing data from wind values in case of interruption of the doppler system. The possible errors in the components, and in the system as a whole, are analysed. This Report is one in the series 485–496 of papers presented at the All Weather Operation Meeting of the AGARD Flight Mechanics Panel, held 12–13 October 1964 in Münich, Germany. Author

N65-27734# Advisory Group for Aeronautical Research and Development, Paris (France).
TESTING OF NAVIGATION SYSTEMS
J. D. Ackerman (Aeroplane and Armament Exptl. Estab.) Oct. 1964 36 p refs
(AGARD-496)

This paper discusses the accuracy of navigational systems and traditional methods of testing under the headings of accuracy, behavior under varying environments, display and compatibility with other systems, collective behavior as a system in a suitable laboratory aircraft, and behavior in the final aircraft type. Author

N65-27874# Aerospace Corp., El Segundo, Calif. Guidance Systems Dept.
A THEORY OF SUBOPTIMAL DATA FILTERING FOR SPACE NAVIGATION
James S. Meditch 31 Mar. 1965 30 p refs
(Contract AF 04(695)-469)
(TDR-469(5107-40)-1; SSD-TR-65-60; AD-465216)

A theory of suboptimal data filtering for space navigation is developed. The method is based on a study of the space navigation problem in its natural form as a problem involving two sets of state variables: the vehicle state variables (usually position and velocity) and the measurement error state variables (such as correlated measurement noise, measurement bias, and landmark location errors). Separate filters are designed for the two sets of state variables by analogy to the Wiener-Kalman formulation. The method provides considerable reduction in the dimension and number of the matrix operations involved in filter synthesis when compared with optimal filter methods. As a result, the onboard computer requirements for space navigation are kept at a minimum. A first-order matrix difference equation for the covariance matrix of the error in the suboptimal estimate is developed. A set of computational flow diagrams for Monte-Carlo simulation of the complete space navigation system is presented. Author

N65-27932# Technical Research Group, Inc., Melville, N. Y.
DOPPLER OPTICAL NAVIGATOR Interim Engineering Report No. 1, 1 Jun.–31 Aug. 1964
A. L. Pogoda, J. T. La Tourrette, S. Jarrett, and S. Jacobs Wright-Patterson AFB, Ohio, AF Avionics Lab. [1964] 36 p refs
(Contract AF 33(615)-1973)
(TRG-019-I-1; AD-610734)

The feasibility of techniques leading to a Doppler optical navigator for measuring instantaneous ground speed with 0.1 ft/sec accuracy at altitudes of 250 to 5000 feet is discussed. Present microwave Doppler radars are limited in short term accuracy due to the large relative bandwidth of the Doppler return signal which is caused by the large beamwidth. A doppler optical sensor using a laser transmitter will generate a narrow beam which results in a Doppler return of narrow bandwidth. The technique discussed uses a CW-laser as a transmitter and detects the Doppler shift in the carrier frequency by optical heterodyne techniques. Signal-to-noise ratio, atmospheric effects, and spectrum width are considered. Also, the laser receiver, detector, system electronics, laser oscillator-amplifier experiments, and scanning noise measurements are included. E.E.B.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-26825 Atomics International, Canoga Park, Calif.
HEAT TRANSFER AND HYDRODYNAMICS RESEARCH COMPACT POWER PROGRAM
L. Bernath and P. D. Cohn *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 89–106 refs (See N65-26812 16-33) CFSTI: $5.50

Boiling water reactors can be designed to yield high performance capability even with net steam generation so long as it is possible to separate the geometric effects required for high intensity cooling from the spatial requirements for a neutron moderator. The analytical program concerned with the burnout conditions and burnout safety factor for conditions which closely simulate the operation of compact reactor cores is discussed. N.E.A.

N65-26832 Dynatech Corp., Cambridge, Mass.
AUTOMATIC EXIT STEAM QUALITY CONTROL FOR BOILING WATER REACTORS
D. A. Gall, E. F. Doyle, and W. M. Rohsenow *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 209–212 refs (See N65-26812 16-33) CFSTI: $5.50

A device which is capable of maintaining a constant exit steam quality is discussed. The comparator displaces a three-way hydraulic valve proportional to the difference of the two venturi tube pressure differentials. The venturi areas are chosen so that the comparator bellows are balanced at the design quality. Thus the comparator is a null-seeking device, in that it is either opening or closing the flow control valve when the exit quality is off the desired condition. Friction in the three-way valve produces a small deadband about the design condition. This device was tested in an air–water system constructed to simulate a range of two-phase flow conditions typical of those encountered in current Boiling Water Reactors (BWR) systems. Test results for the air–water system show that the control device operates as predicted. Subsequently the control system was tested in a high pressure steam–water loop at a pressure of 1,000 psi. The results for one of the transients is given. It is shown that the transient response was completed in about ten seconds for the system tested. To apply this device to a BWR, instead of supplying a constant flow rate to the reactor, it will be necessary to maintain a constant pressure drop across the reactor, with the steam quality control device dictating the system flow rate. N.E.A.

N65-26836 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France).
ADAPTATION OF SWIRL FLOW TO BWR
Claude Moussez *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 273–280 refs (See N65-26812 16-33) CFSTI: $5.50

Work undertaken to define a technique using adjacent helical flows, adjustable to different geometry types and operating requirements used in nuclear reactors cooled by boiling water and then to gather data required to approach a design, particularly on pressure drops, void fractions and critical fluxes and at least to better understand these phenomena is discussed. Tests studied a comparison between straight flow and vortex flow; the three principal values for which correlations were investigated are: (1) void fraction; (2) pressure drop; and (3) critical flux. Devices for these experiments were of two types: (1) nonthermal device with half-open cycle; and (2) thermal devices, loops in closed circuit. The hydrodynamic and thermal tests are discussed. N.E.A.

N65-26839 AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).
RESEARCH PROGRAM ON BOILING WATER REACTOR DYNAMICS
A. Kirchenmayer *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 311–316 (See N65-26812 16-33) CFSTI: $5.50

An analytical model describing the dynamic behavior of boiling water reactors is discussed. Instabilities observed in boiling water reactors indicate two types of feedback mechanisms leading to oscillations of the nuclear power and inlet water flow rate: (1) reactivity feedback; and (2) hydraulic feedback. For large boiling water reactors an important problem is treatment of a single channel at given pressure difference between inlet and outlet. Having a model for this case, more complex problems can be calculated. The variables to be calculated by the model for a single channel or reactivity and the water flow rate. The mathematical formulation and efforts in solving the problem are discussed. The experimental facility and program is presented. N.E.A.

N65-26957# California Univ., Livermore, Lawrence Radiation Lab.
HAZARDS CONTROL Quarterly Report No. 20, Jan.–Mar. 1965
R. L. Kathren et al [1965] 62 p refs
(Contract W-7405-ENG-48)
(UCRL-14151) CFSTI: $3.00

Investigations were continued on the development of radiation hazard control devices. K-fluorescent X-ray sources were shown to provide clean and uniform monoenergetic spectra with variable intensity. An automatic sampler changer was constructed for counting up to 100 4-inch by 9-inch air filter papers. The design of a large area gas flow proportional detector for use as an automatic sample changer or as a manual probe was initiated. A shield was constructed that provides a low background environment for low level gamma pulse-height analysis and minimizes transient gamma and neutron field effects. A trailer was equipped for continuous air monitoring of fission product gases. Thermoluminescent dosimeters were used to measure gamma ray dose rates in reactor thermal columns, irradiation facilities, and core. Solid state detectors improved the analysis of natural airborne background. Respirator kits for emergency or hazardous use were assembled. The quick-disconnect coupling for the air line respirator hose was modified to prevent inadvertent release. Fiberglass ladders provide good service with proper maintenance and inspection. R.N.A.

N65-26967# Atomics International, Canoga Park, Calif.
IRRADIATION OF SNAP 10A CONTROL DRUM DRIVE ACTUATORS AND POSITION SENSORS
M. Warren 15 May 1965 66 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10717)

Two flight type control drum drive actuators and two flight type control drum position sensors were subjected to nuclear radiation as part of a program to evaluate the effects of reactor radiation on the electrical properties and operation of the high temperature electrical components of the SNAP

10A reactor control system. This experiment also served as part of a program to qualify these components for flight reactor use. These components were tested in the combined environment of reactor radiation, high temperature and vacuum in order to simulate the SNAP-10A reactor operational environment during space flight. All of the test components performed properly during this experiment. The radiation environment had no apparent effect on the functionality or performance of the test devices. The functionality of each component was tested in-pile as the experiment proceeded. All performance data such as coil resistances, electrical insulation resistances, and temperatures were also measured in-pile throughout the experiment. The test components were subjected to postirradiation examinations in a hot cell. Static and dynamic torque measurements were performed. The actuators were completely disassembled and the internal parts were carefully examined for signs of damage. The examinations showed that there were no significant changes that occurred that could be attributed to the radiation environment. The slight variations in appearance from that of a new component were attributed to the high temperature operating environment. Author

N65-26986# AiResearch Mfg. Co., Phoenix, Ariz.
CLOSED-BRAYTON-CYCLE SOLAR-POWER-UNIT RESEARCH AND DEVELOPMENT PROGRAM Technical Documentary Report, May 1963–May 1964
A. Pietsch Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Sep. 1964 441 p refs
(Contract AF 33(657)-11721)
(APL-TDR-64-103; AD-610043)

A 3.2-inch-diameter compressor, corresponding to a system output power level of 30 kw, was designed, fabricated, and tested with better than 80 percent total-to-total efficiency resulting. Testing of hydrostatic, porous-shoe, flexible mounted gas bearings on a single-shoe and on a dynamic two-bearing test rig was not satisfactory, and a change of the shoe to solid material with hydrostatic orifices mounted in the bearing surfaces was recommended. Testing of internally finned tubes for radiator fluid passages showed good agreement with theoretical results for the friction-factor portion of the tests. Manifold distribution and pressure-drop tests established the flow configuration for minimum nonuniformity and pressure drop across a radiator panel. A lithium-fluoride hot-filled technique was developed to fill a cavity which was then used for heat-transfer tests. The heat-transfer/storage unit configuration was redefined. G.G.

N65-27015# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MICROWAVE NEUTRON FLUX MONITORING DEVELOPMENTS Progress Report
D. P. Brown and N. S. Porter Feb. 1965 27 p refs
(Contract AT(45-1)-1830)
(BNWL-38) CFSTI: $2.00

Microwave in-core neutron flux experiments were conducted in a water-cooled facility in the Hanford KW-Reactor. Seven different experiments were conducted during the year. Six resonant cavities were developed and used with nitrogen and helium gases, with nitrogen being used only in the initial experiment. Two of the cavities were of the transmission type employing different waveguides for the transmission and the return signals; the others were reaction cavities on a single waveguide with a directional coupler for use in signal acquisition. The reactor in-core tests followed extensive laboratory experiments using different configurations and artificially ionized plasmas. A series of in-core tests employing reaction cavities have established a definite relationship between neutron flux density and cavity resonant frequency when using an excitation frequency of about 30 GHz. A single experiment, using the cross-coupling attenuation concept, was performed and the data demonstrated a promising relationship between the probe position in the reactor core and the attenuation of the transmitted signal. No experiments have been conducted using microwave noise or in-line attenuation techniques.
N.E.A.

N65-27017# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.
IRRADIATION EFFECTS IN THE EGCR FUEL
C. D. Baumann Jun. 1965 167 p refs
(Contract W-7405-ENG-26)
(ORNL-3504) CFSTI: $5.00

Two general types of experiments were carried out concurrently to develop the fuel elements for the initial loading of the EGCR. A series of 16 prototype elements were tested in the ORR and 22 miniature fuel capsules were irradiated in the Low-Intensity Test Reactor (LITR). The prototype elements were similar to the proposed EGCR elements except that (1) the ends of the pellets were not dished; (2) the length was two-ninths that of the proposed element; and (3) in some cases pellet geometry differed. The general purpose of these experiments was to proof-test the proposed EGCR elements and, particularly, to investigate pellet-geometry effects. The miniature fuel capsule experiments were designed primarily to investigate the dependence of fission-gas release upon fuel characteristics and upon operating conditions. The miniature fuel experiments showed that fission-gas release (1) increased for burnups above about 15,000 Mwd per metric ton of UO_2; (2) increased as burnup rate increased; (3) was quite sensitive to fuel structure, that is, the smaller the ratio of closed voids to total voids, the better the fission-gas retention; (4) dependence on O/U ratio was confused by density effects; and (5) diffusion constants for xenon and krypton were about the same. Author

N65-27041# Hanford Atomic Products Operation, Richland, Wash.
RESEARCH AND DEVELOPMENT PROGRAMS EXECUTED FOR THE DIVISION OF REACTOR DEVELOPMENT OCTOBER, NOVEMBER, DECEMBER, 1964 Quarterly Progress Report
J. K. Green, ed. Dec. 1964 79 p refs
(Contract AT(45-1)-1350)
(HW-84609) CFSTI: $3.00

Work was continued on studies of basic properties of fuel materials and fabrication methods, physics, chemical processing of reactor fuels and radioactive waste, material development, irradiation effects on materials, fuel cycle analysis and advanced concepts, instrumentation, and nondestructive testing techniques. L.S.

N65-27114# Joint Publications Research Service, Washington, D. C.
YUGOSLAV RADIOACTIVE PRODUCTS FOR INDUSTRIAL USES
Cedomir Teofilovski 23 Jun. 1965 17 p refs Transl. into ENGLISH from Tehnika (Belgrade), no. 4, Apr. 1965 p 644–649
(JPRS-30771; TT-65-31327) CFSTI: $1.00

An analysis of conditions that should contribute to the development of radioisotope production in Yugoslavia, and applications of radioisotopes within the country is discussed. Possibilities offered by the reactor, at the Boris Kidric Institute for Nuclear Sciences, for the irradiation of materials are considered. Tables are presented showing the growth in the quantity of Ir^{192} delivered in the period 1961–1964, and the

share of Yugoslavia's production of Ir^{192} compared to production of the isotope in other European countries during 1962–1964. It is Yugoslavia's intention to reach Belgium's 1963 production in the shortest time possible. Progress in making Co^{60} is reported, and reasons are cited for the industrial use of short-lived radioisotopes with a half-life of up to 65 hrs. A tabulation is given of short-lived radioisotopes, together with the mode of chemical treatment of the irradiated targets in producing the isotopes. The usefulness of a catalog of radioactive products, and factors in maintaining domestic radioisotope production are discussed. Pictures of the equipment for producing radioactive isotope solutions are shown. L.S.

N65-27212# General Nuclear Engineering Corp., Dunedin, Fla.

HYDRAULIC BALL (HY-BALL) CONTROL SYSTEM DEVELOPMENT PROGRAM Final Report

S. J. Weems, S. E. Turner, R. L. Lyerly, D. J. Blair, and W. S. O'Brien Washington, AEC, 5 Jun. 1964 326 p refs
(Contract AT(38-1)-207)
(SROO-207-30) CFSTI: $4.00

A hydraulic ball (Hy-Ball) reactor control system was developed for a conventional 300-Mw(e) boiling water reactor. This system has many advantages over the conventional rod drive system. Reactor core power output and performance are increased. The small size and symmetric location of the Hy-Ball columns eliminates the water channel peaking factor associated with control rods. The system is designed to be reasonably fail safe. The optimum control element diameter of the Hy-Ball columns was determined at 1/2 inch. Simple round cross-section tubing was selected for the column shape. Boron–stainless steel ball control element configurations were selected as the neutron-absorbing material. An open bottom plumbing system was chosen for the operation of five Hy-Ball columns from a single control circuit with the columns connected hydraulically in parallel. A pilot operated main valve system for controlling the water in and out of a control pipe line was selected. Zircaloy-4 Hy-Ball columns and valve system operated satisfactorily with reactor and room temperature water over a span of many reactor lifetime cycles. R.N.A.

N65-27373*# Lockheed-Georgia Co., Marietta, Georgia Nuclear Labs.

GAMMA SPECTRUM MEASUREMENTS, SNAP 8 RADIATION EFFECTS TEST PROGRAM, VOLUME I

Sep. 1964 22 p refs Prepared for Aerojet-General Corp.
(Contract NAS5-417)
(NASA-CR-63600; ER-7448) CFSTI: HC $1.00/MF $0.50 CSCL 18N

The gamma spectra of the Radiation Effects Reactor was measured with three external shield configurations, i.e., 16 inches of Lithium Hydride, 16 inches of Lithium Hydride plus 8 inches of water, and 8 inches of water. These measurements were made with a collimated single crystal sodium iodide scintillator (4" × 5" diameter). Histogram photon and dose distributions were then computed by means of a 33 × 33 inversion matrix. These measurements show considerable hardening of the basic reactor spectrum, i.e., the U-235 fission spectrum plus capture gammas from the reactor coolant and structural materials. Data reveals that Lithium Hydride is not unique in shaping the resultant filtered spectra, but instead demonstrates effects similar to those produced by water. The measured dose distribution shows qualitative agreement with the calculated SNAP-8 environment. Author

N65-27394*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio.

OPERATION OF A FORCED CIRCULATION, HAYNES ALLOY NO. 25, MERCURY LOOP TO STUDY CORROSION PRODUCT SEPARATION TECHNIQUES

David B. Cooper Washington, NASA, Jul. 1965 73 p refs
(Contract NAS5-462)
(NASA-CR-241) CFSTI: HC $3.00/MF $0.75 CSCL 18G

A Haynes alloy No. 25, forced circulation, mercury loop was designed and operated for a total of 5218 hours at an average boiling temperature of 1097° F. Corrosion product separators were included in both the vapor and liquid sections of the system and were evaluated for their effectiveness in reducing problems associated with mass transfer in mercury systems. The vapor corrosion product separator was approximately 51 percent efficient in removing corrosion products carried over from the boiler. Operation of this loop for 5218 hours has demonstrated the feasibility of long-term operation of a Haynes alloy No. 25 mercury system. Author

N65-27405# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

BURNUP DETERMINATION OF NUCLEAR FUELS: 1964 Annual Report

W. J. Maeck and J. E. Rein, ed. May 1965 50 p refs
(Contract AT(10-1)-205)
(IDO-14656) CFSTI: $2.00

Methods for the determination of burnup of nuclear fuels are discussed. The major analytical technique being investigated is stable fission product analysis. The preparation of standard burnup and fission yield samples is presented. Chemical separations, the evaluation of several methods for stable fission product analysis, the preparation of standards for mass spectrometric analysis and the dissolution of fuel samples are discussed. Author

N65-27412# Los Alamos Scientific Lab., N. Mex.

CONTROL ROD CALCULATION TECHNIQUES WITH APPLICATIONS TO THE UHTREX REACTOR

B. M. Carmichael and R. J. LaBauve 7 Jun. 1965 92 p refs
(Contract W-7405-ENG-36)
(LA-3194) CFSTI: $4.00

Two-group, multiregion, analytic calculations of control ring worths in UHTREX are compared with results from two-dimensional, diffusion theory (CRAM code), and two-dimensional, S_n, transport theory (DDK code). Author

N65-27413# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).

ANNULAR PELLET ROD MOCKUP EXPERIMENT IN ZEEP

R. E. Green Apr. 1965 5 p refs
(AECL-2247)

Radial and axial flux distributions have been measured in an annular UO_2 pellet rod mockup assembly installed in the ZEEP reactor. The measurements provide data necessary for the determination of heat transfer coefficients in an actual loop experiment being done in the NRX reactor, and also confirm that "flux peaking" at the ends of a fuel charge can be essentially eliminated by using stainless steel spacers as "flux suppressors". Author

N65-27560# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE CRITICAL HEAT FLUX FOR TUBULAR FUEL ELEMENTS OF AN ATOMIC POWER PLANT

V. A. Zenkevich, O. L. Peskov, and V. I. Subbotin 7 Apr. 1965 11 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 6, 1964 p 20–22
(FTD-TT-65-295/1+2; AD-614769)

The results of investigating the boiling crisis during the flow of subcooled water and a steam-water mixture in tubes are given. The validity of using data obtained in tubes for calculating the critical heat flux in the tubular fuel elements of nuclear reactors is substantiated. Author

N65-27576# General Dynamics/Fort Worth, Tex.
AN INVESTIGATION OF THE THERMAL RESPONSE OF THE AEROSPACE SHIELD TEST REACTOR TO LOSS OF COOLANT Technical Report, 1 Oct. 1963–30 Sep. 1964
R. A. Lawrence Kirtland AFB, N. Mex., AF Weapons Lab., Apr. 1965 103 p refs
(Contract AF-(601)-6213)
(WL-TR-64-137; FZK-209; AD-614452)

The primary purpose of this experiment was to determine the possible consequence of a complete loss of coolant from the interior of a reactor, specifically the ASTR. The results are somewhat applicable to other reactors having similar materials and configurations. A heat-transfer model was developed and compared with experimental data. This comparison revealed that the model was conservative and that the heating rate and heat-loss rate were excessive. The experimental data were acquired from the ASTR in a series of tests that involved removal of the coolant from the reactor following operation at various power levels and operating times. It is concluded that operation conditions for threshold melting can be predicted and that fuel-element peak temperatures resulting from loss of coolant are relatively unaffected by the reactor being in either air or water. It is further concluded that overheated fuel elements can be cooled by adding water, with relatively little hazard of rupturing a fuel plate. Author

N65-27600# Los Alamos Scientific Lab., N. Mex.
CONTROLLED THERMONUCLEAR RESEARCH PROGRAM Semiannual Status Report, Period Ending 30 Apr. 1965
May 1965 110 p refs
(Contract W-7405-ENG-36)
(LA-3320-MS; UC-20) CFSTI: $4.00

A number of investigations are being conducted under a controlled thermonuclear research program. Included are computation of pulsed magnetic and electrostatic fields in caulked cusps, E × B plasma heating in mirror geometry, dense plasma focus experiment, vacuum spark gap investigation, one-quarter megajoule vacuum switched capacitor bank, a slingshot plasma accelerator, adiabatic invariants, construction of energy level diagrams from transition energies, numerical integration of differential equations, toroidal caulked cusp design, caulked cusp design calculations, inductive energy storage, switching for inductive energy storage, hydromagnetic plasma gun program, framing camera pictures of plasma gun discharge, vacuum technology, orbitron pump, glass implosion studies, Scylla IV operation, electron density produced by the preionizer in Scylla IV, a toroidal confinement system for theta-pinch plasmas with interchange stabilization, proposal for a closed toroidal theta pinch, a curved compression coil design for Scylla IV, and a pulsed-reactor feasibility study. R.N.A.

N65-27603# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR DEVELOPMENT PROGRAM First Quarterly Report, Apr.–Jun. 1964
K. M. Horst, ed. Washington, AEC, Jul. 1964 63 p refs
(Contract AT(04-3)-540)
(GEAP-4594) CFSTI: $3.00

Preliminary information was calculated on the effects of the total reactivity and reactivity insertion rates on the prompt critical transients. Frequency ranges and displacements required for the oscillator experiments were investigated. Also, preliminary values of the errors in measurement that might arise from changes in reactor power, sodium temperature, reactivity, and fuel temperature were estimated in support of the planning for the static Doppler measurements. Planning of the experimental transient program was undertaken with the consideration of experiments that can best evaluate the effects of such parameters as fuel-clad differential expansion, slumping, thermal ratcheting, and vapor pressure upon fuel failure mechanisms. Further, a 60-group set of cross sections, revised to conform to recent experimental data, was prepared for the core physics analysis. It was shown that the Doppler coefficient is relatively insensitive to the changes in core parameters considered. E.E.B.

N65-27627# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report
R. M. Adams and A. Glassner 25 Jun. 1965 96 p refs
(Contract W-31-109-ENG-38)
(ANL-7046) CFSTI: $3.00

The experimental breeder reactor (EBR-II) successfully completed its scheduled run to about 0.8 atm% maximum burnup and was shut down for fuel inspection. The first fuel irradiation test in ERB-II was completed and the irradiation subassembly removed from the reactor. Also, calibration runs were conducted using a bare fuel pin in the reactor and good results were obtained from both fuel element rupture detection systems. Further, the rod-drop and trapezoidal oscillation methods of monitoring the reactor kinetics were tested and found satisfactory. The A–E Title II design was essentially complete and the ANL design was about 60% complete for the FARET liquid-metal-cooled reactor. Progress is also reported for *General Reactor Technology*; *Advanced Systems Research and Development*; and *Nuclear Safety*. E.E.B.

N65-27629# Los Alamos Scientific Lab., N. Mex.
APPLICATION OF MINIATURE INTRINSIC THERMOCOUPLES FOR REACTOR-TRANSIENT DIAGNOSTICS
Roderick G. Morrison 14 Jun. 1965 30 p
(Contract W-7405-ENG-36)
(LA-3313-MS)

In a reactor environment, the effects of radiation on the sensing element used in electrical measurements sometimes obscures the desired data. The nature of thermoelectric sensors is such that these effects can be held to a minimum. The use of the actual fuel material as a part of the sensing element removes most energy transfer functions and enables one to measure energy deposition directly as a temperature increase. To overcome thermal time lags and come closer to actual temperatures, fine thermocouple wires .001" in diameter were welded to small fuel particles .016" in diameter. This report covers the techniques used and the data results from an experiment conducted on Kiwi-TNT. Author

N65-27692*# Aerojet-General Corp., Sacramento, Calif.
DESIGN STUDY OF MODIFICATION OF M-1 LIQUID HYDROGEN TURBOPUMP FOR USE IN NUCLEAR REACTOR TEST FACILITY
W. H. Knuth, J. Farquhar, and B. Lindley 15 May 1965 128 p
(Contract NAS3-2555)
(NASA-CR-54422; AGC-8800-5) CFSTI: HC $4.00/MF $1.00
CSCL 18I

A design study was conducted to determine the capability of adapting the M-1 fuel turbopump to satisfy the requirements of the PHOEBUS II Reactor Liquid Hydrogen Feed System. Appropriate design and performance analyses as well as mechanical design effort were performed to the extent needed to permit rapid transition into a development program. A 20% stall margin is predicted for the resulting pump hydraulic geometry at the nominal PHOEBUS operating point. A nominal speed of 11,500 rpm will be required to produce a 1400 psi pressure rise at a hydrogen weight flow of 350 lb/sec. The predicted nominal turbine weight flow is approximately 55 lb/sec. Author

N65-27693# Brookhaven National Lab., Upton, N. Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW Bimonthly Technical Progress Review, Volume 3, No. 2
O. E. Dwyer, ed. Apr. 1965 55 p Sponsored by AEC
(BNL-928(PR-14)) CFSTI: $3.00

Current research in high temperature liquid metal technology is reviewed. Included are investigations on alkali metals, forced convections vaporization of potassium in a single tube, reactor development, mercury and the kinetic theory of condensation, sodium technology loop, liquid metal technology relevant to the SNAP program, sodium heated steam generator, high temperature refractory metals and alloys for thermionic converters, electrical and thermal conductivity of liquid rubidium, vapor pressure of rubidium, the saturated liquid and vapor density, and critical temperature of cesium, the electrical and thermal conductivity of liquid cesium, boiling and condensing of alkali metals, spacecraft and powerplant integration problems, sodium cooled reactors fast ceramic reactor development, high acceleration field heat transfer for auxiliary space nuclear power systems, multicomponent alkali metal alloys, effect of high temperature sodium on austenitic and ferritic steels, methods for determining carbon, oxygen, and nitrogen in alkali metals, liquid metal lubricated bearings, and liquid metal boiling heat transfer. R.N.A.

N65-27788# General Electric Co., Cincinnati, Ohio. Advanced Technology Services
HIGH-TEMPERATURE MATERIALS PROGRAM Progress Report No. 47, Part A
28 May 1965 107 p refs
(Contract AT(40-1)-2847)
(GEMP-47A) CFSTI: $4.00

Progress is reported for oxidation-resistant fuel element materials, high temperature reactor, thermocouple, and electric materials, and the effect of radiation on high-temperature metals and alloys. Among the specific research was the laboratory testing of Fe–Cr–Al–Y clad fueled specimens at 1100° and 950° C for 6700 hrs in air with continuing indication of excellent stability. Also, creep-rupture tests of arc-cast tungsten were completed at several stress levels at 1600° to 2810° C. The thermoelectric potentials to 1800° C of 12 materials with low neutron-capture cross sections indicated Mo, Mo–1Ru, and Mo–10s (at.%) vs Nb have merit as thermocouples to 1200° C and possibly higher by modifying the Nb. It was found that the electrical resistivity of ThO_2 and BeO is influenced by oxygen partial pressure at 1400° C. E.E.B.

N65-27789# General Electric Co., Cincinnati, Ohio. Atomic Products Div.
HIGH-TEMPERATURE MATERIALS PROGRAM Progress Report No. 48, Part A
25 Jun. 1965 33 p refs
(Contract AT(40-1)-2847)
(GEMP-48A) CFSTI: $2.00

Progress is reported on fission gas diffusion in unfueled ceramic materials, fission product transport processes in refractory-metal fuel systems, internal conversion ceramic fuel element research, and the radiation effects in BeO. Among the specific results reported was that electron micrographs of polished sections of the 20-micron grain size BeO samples irradiated at 1000° C to 2.5×10^{21} nvt failed to yield evidence of microcracking. Krypton was dissolved and diffused in tantalum cathode samples which were self-resistively heated to 1730° C while under glow discharge for different exposure times and pressures. Analysis indicated that diffusion along high diffusivity paths was the dominant transport process beyond about 400 Å. Chemical analysis of UO_2–ThO_2 and UO_2–ThO_2–Y_2O_3 fueled-BeO specimens that completed extended fuel retention tests at high temperatures in various atmospheres confirmed the excellent stability of the Y_2O_3-containing compositions. E.E.B.

N65-27883# Space Technology Labs., Redondo Beach, Calif.
SHOCK SPECTRUM MEASUREMENTS, VELA UNIFORM, PLOWSHARE PROGRAM, PROJECT GNOME, PROJECT 1.7
Frank W. Galbraith and M. V. Barton Washington, D. C., Defense Dept., 2 Jul. 1965 31 p refs
(VUF-2401) CFSTI: $2.00

A total of twelve reed gages were installed to measure displacement shock spectra resulting from the Project Gnome underground nuclear explosion. Seven of the gages were installed on the ground surface at four locations out to a distance of 3000 feet from surface zero. All of these gages yielded usable records. Four of the gages were installed in the floor of the Gnome tunnel at two locations. Those at the 1033-foot range gave valid records; those at the 900-foot range were not recovered after the test. The one gage located underground at the International Minerals and Chemical Corporation (IMCC) mine, some nine miles distant, did not record any motion. The plotted displacement spectra showed the expected results in that displacements and peak accelerations decreased with increasing slant range for the surface gages. The vertical spectra were higher than the corresponding horizontal radial spectra for the surface gages. For the gages in the Gnome tunnel, the horizontal radial spectrum was higher than the vertical spectrum. Author

N65-27884# Battelle-Northwest, Richland, Wash. Chemistry Dept.
FIXATION OF RADIOACTIVE RESIDUES: RESEARCH AND DEVELOPMENT ACTIVITIES Quarterly Progress Report No. 25, Jan.–Mar. 1965
A. M. Platt, ed. Apr. 1965 44 p
(Contract AT(45-1)-1830)
(BNWL-76) CFSTI: $3.00

Research and development activities in the field of radioactive wastes are continuing. Leaching tests on high level phosphate glass corroborated earlier indications that dry storage is essential for maintaining low leachability with moist air being more deleterious to the glass surface than immersion in water. Drip temperature and solubility measurements on phosphate mixtures of synthetic fission product and process oxides were completed. The hot spray calciner was dismantled and revealed extensive corrosion of the Inconel wall with some stress cracking. SO_3 evolution from melts composed of Purex 1WW waste and phosphate was more severe than from Purex 1WW–B_2O_3 melts. The sulfate percentage retained in the 1WW–phosphate melts held at 950° C for 3 hrs decreased as the sulfate concentration in the waste increased. Platinum in a platinum–Inconel 600–platinum sandwich was attacked when exposed in a Purex 1WW melt at 1100° C but not at lower temperatures. Solid fluxing agent addition to the spray calciner-melter as a means of glass formation was feasible. R.N.A.

N65-27898# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.
FOOD-CHAIN RELATIONSHIPS OF RADIOSTRONTIUM IN THE SEDAN FALLOUT FIELD Final Report
William E. Martin and Frederick B. Turner Mar. 1965 70 p refs
(Contract AT(04-1)-GEN-12; Proj. Sedan)
(PNE-237F) CFSTI: $3.00

Plant samples and rabbits were collected before and at various times after the nuclear detonation from 20 locations in the Sedan fallout field. Radiochemical analyses were made to determine the concentrations of Sr-89 and Sr-90 in dry plant samples and in the bond ash of the rabbits at the times of collection. Average concentrations of Sr-89 in plant samples and in the bone ash collected on D + 5 days were about 100 times higher than the average concentrations of Sr-90. The average concentrations of Sr-89 and Sr-90 in rabbit bone ash increased rapidly from D + 5 days to D + 15 days and then more slowly from D + 15 to D + 30. Maximum levels were attained at D + 30 days. A mathematical model incorporating the appropriate parameters was formulated and found to function satisfactorily with values derived from the radiochemical data. The estimated doses to individual rabbits ranged from 0.11 to 9.48 rad with an average value of 1.12 ±0.36 rad. Also, a mathematical model was proposed to provide at least a partial explanation of the quantitative-kinetics of Sr-89 or I-131 on plants, milk, and human tissue following such a detonation. E.E.B.

N65-27899# Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering.
IN-PILE LOOP IRRADIATION STUDIES OF ORGANIC COOLANT MATERIALS Progress Report, Oct. 1, 1963–Dec. 31, 1964
E. A. Mason Washington, AEC, 1 Feb. 1965 28 p refs
(Contract AT(38-1)-334)
(MIT-334-12; MITNE-59) CFSTI: $2.00

Irradiation of Santowax WR at a fast neutron fraction of 40% at temperatures of 425° F to 800° F were completed. The irradiations were carried out with steady-state distillation processing and recycle of the coolant. Samples of degradation gases were analyzed and the gas generation rate determined. Analysis of the results on the decomposition of terphenyls using first-order kinetics indicated that the rate of pyrolysis of irradiated coolant is much greater than that of unirradiated coolant. Also, a series of six measurements of dose rate by calorimetry were carried out; some difficulty with the use of polyethylene as an energy absorber was experienced. Heat transfer measurements indicated no evidence of fouling over long periods of loop operations. Work was also completed on fractionation of high boiler formed during irradiation of Santowax OMP and on determination of the molecular weight of the various fractions. Further, the in-pile section was designed, procured, delivered, and acceptance tested. E.E.B.

N65-27938# Los Alamos Scientific Lab., N. Mex.
INTEGRAL GAMMA AND NEUTRON MEASUREMENTS ON THE NRX-A2 REACTOR
F. C. V. Worman and P. K. Lee 14 Jun. 1965 31 p refs
(Contract W-7405-ENG-36)
(LA-3296-MS) CFSTI: $2.00

This report presents data obtained on integral neutron fluxes and gamma and neutron rad doses measured on Experimental Plans 2, 4, and 5 of the NRX-A2 reactor tests. Studies included a 2,700-foot free-line, a meridian ring, and an equatorial ring. Neutron fluxes and gamma and neutron rad doses exhibited a close approximation to an inverse square relationship, with air attenuation, along the freeline. Since the NRX-A2 reactor was similar to the Kiwi B reactors, data were compared with earlier Kiwi B data. Information obtained from these studies indicated that the radiation leakage patterns observed for NRX-A2 were very similar to those of the reactors of the Kiwi B series. Author

N65-27940# General Dynamics Corp., San Diego, Calif. General Atomic Div.
UTILIZATION OF REACTOR FAST NEUTRONS FOR ACTIVATION ANALYSIS Second Annual Report, Period Ending Nov. 30, 1964
H. P. Yule, H. R. Lukens, Jr., and V. P. Guinn Washington, AEC, 14 Dec. 1964 96 p refs
(Contract AT(04-3)-167)
(GA-5978) CFSTI: $3.00

The decay gamma-ray photopeak yields, and corresponding element detection limits, were calculated for 896 nuclear reactions. Reactor fast-neutron products of 71 elements were searched for experimentally and where observed, the fast-neutron product yields were measured. Experimental sensitivities were then calculated and pulse-height spectra were obtained. The calculated yields were compared with the experimental yields for 100 thermal-neutron (n,γ) reactions and 46 reactor fast-neutron reactions. It was found that the reactor fast-neutron activation for the instrumental detection of eight elements was more sensitive than reactor thermal-neutron activation and was quite sensitive for the detection of 24 additional elements. It was also found that reactor pulses produced enhancements of neutron-induced sensitivities for short-lived products by factors of about 700 for activities with half-lives of 0.1 sec, 70 for 1-sec half-life species, and 7 for 10-sec half-life products. A combination of reactor pulsing, multichannel scaling, and computer calculation is shown to provide much more precise and accurate half-lives for short-lived products than the best currently available literature values. E.E.B.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-26860* Army Missile Command, Huntsville, Ala.
NUMERICAL SOLUTIONS OF THE FRESNEL EQUATIONS IN THE OPTICAL REGION
Herbert B. Holl *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 45–61 ref (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

The solutions of the Fresnel equations, which are obtained for approximately 2,500 indices of refraction for normal and oblique incidence, are discussed. Several examples of the graphic illustration of these solutions are given, and the discussion describes in detail the occurrence of reflection characteristics such as the angle of incidence for which (a) the amplitude of the wave oscillating parallel to the plane of incidence is a minimum; (b) the degree of polarization is a maximum; and (c) the two amplitudes of the reflected wave have a difference in phase of 90°. Some examples of the determination of the index of refraction from reflection measurements are also given. Author

N65-26871* Little (Arthur D.), Inc., Cambridge, Mass.
SURFACE PROPERTIES OF METALS
H. H. Blau, Jr. and H. A. Francis *In* NASA. Washington Symp. on Thermal Radiation of Solids 1965 p 159–163 *ref* (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

Data are presented to show the effect of surface oxidation, caused by heating in air, on the spectral emittance (2 to 14 μ of caused by heating in air, on the spectral emittance (2 to 14 μ) of stainless steel. Also presented are the spectral emittance data for platinum and Inconel surfaces coated with silicon monoxide 1000 Å thick and then heated in air. A method is described for obtaining aluminum surfaces with periodic distributions of ridges (two-dimensional roughness) or of hillocks (three-dimensional roughness) with periodicities of several hundred angstroms. Author

N65-26872* National Bureau of Standards, Washington, D. C.
DIFFUSE SPECTRAL REFLECTANCE OF METAL SURFACES
H. J. Keegan, J. C. Schleter, and V. R. Weidner *In* NASA. Washington Symp. on Thermal Radiation of Solids 1965 p 165–169 refs Sponsored in part by ARPA (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

Described is an attempt to correlate the effect of surface finish (texture) on the diffuse spectral directional reflectance of metals; measurements were made over the wavelength range from 0.2 to 2.1 μ for samples of sintered beryllium, steel gage blocks, steels machine-lapped with various types and sizes of abrasives, polished and sandblasted aluminum, platinum, and a chemically polished beryllium block. Author

N65-26878* Ling-Temco-Vought, Inc., Dallas, Tex. Astronautics Div.
LIGHT-SCATTERING BEHAVIOR OF PIGMENTED COATINGS
R. L. Cox *In* NASA. Washington Symp. on Thermal Radiation of Solids 1965 p 205–209 (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

Finely milled glass pigment particles (sizes ranging from about 0.3μ to about 1.3μ) were lightly sintered to form coatings. Porosity, particle size, and particle shape were evaluated by using an electron microscope, and reflectance measurements were made over the wave-length range of 0.2 to 2.0μ. Results are compared with theory. It is shown that single-particle scattering theory affords reasonable quantitative predictions of the reflectance of thin, intensely scattering, coatings when an empirical correction factor is employed to account for proximity effects at high particle concentrations. Author

N65-26959# Joint Publications Research Service, Washington, D. C.
THE USE OF SHOCK WAVES IN HIGH-PRESSURE PHYSICS
L. V. Al'tshuler 25 Jun. 1965 95 p refs Transl. into ENGLISH from Usp. Fiz. Nauk (Moscow), v. 85, no. 2, Feb. 1965 p 197–258
(JPRS-30799; TT-65-31343)

A survey on studies of shock wave application in high-pressure physics of explosives, in the equations of state for super-dense gases, metals, and ionic and valent crystals is given. Also discussed are phase transformations in shock waves, problems concerning the dynamic strength of metals, and the conductivity induced by shock. Problems involving impulse X-raying, and the investigation of the optical properties of shock-compressed substances were only partly included. G.G.

N65-26983# Oklahoma Univ., Norman. School of Aerospace and Mechanical Engineering
THE EFFECT OF WALL TEMPERATURE ON THE OPERATION OF THE RIJKE TUBE
Quitman W. Lott (M.S. Thesis) 1965 46 p refs
(Contract AF 33(608)-1096)
(AD-612249)

The construction of an experimental Rijke tube and the investigation of the parameters, velocity, heater power, and wall temperature are described. It was found that: (1) Sound intensity is not a function of tube wall temperature. (2) Heat transfer to the tube wall is not an important parameter in the mechanism of heat-driven oscillations. (3) The heat-driven oscillations occur at very low air velocities. (4) Air velocity is an important parameter only near the minimum and maximum air velocities. (5) The maximum air velocity is approximately a linear function of heater power. (6) Sound intensity is approximately a linear function of heater power. The salient features of these parametric relationships were not discernible from the analyses reviewed in the literature survey which was made during this research. E.E.B.

N65-26985# Princeton Univ., N. J.
DIELECTRIC RELAXATION AND STRUCTURE Progress Report, 1 Apr.–30 Sep. 1964
Charles P. Smyth [1964] 7 p refs
(Contract DA-31-124-ARO-D-109)
(PR-4; AD-611061)

The measurements of dielectric constant and loss for eight rigid molecules at 2.2 mm wavelength at various temperatures were used to obtain the optical dielectric constant. The value of this constant was close to the square of the refractive index and there seemed to be no evidence of the additional ultra-high frequency dispersion region suggested by the results of previous work. The values of the optical dielectric constant were used to calculate atomic polarizations. General agreement was obtained with values determined for the molecules in the gaseous state. Also, the dielectric constants and losses of ten primary alkyl alcohols at various temperatures and at 16 wavelengths were used to characterize different mechanisms of dielectric relaxation in these compounds. Further, dielectric data on a series of α,ω-dibromoalkanes; on seven water-dioxane mixtures; and of binary mixtures of benzophenone in tetrahydrofuran, pyridine and chloroform, 2-chloronaphthalene in pyridine, and 4-iodobiphenyl in chloroform were determined and analyzed in terms of relaxation times. E.E.B.

N65-27023*# Rice Univ., Houston, Tex.
RESEARCH ON THE PHYSICS OF SOLID MATERIALS Semiannual Status Report No. 12, 1 Nov. 1964–30 Apr. 1965
Franz R. Brotzen 8 Jun. 1965 20 p refs
(Grant NsG-6-59)
(NASA-CR-63512) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Progress is reported on research on the physics of solid materials done at Rice University. The research is carried out in six departments which are doing various projects in solid state physics, physical metallurgy, and chemistry of solids. Some of the projects investigated are (1) paramagnetic spin-lattice interactions; (2) ferromagnetic spin-lattice interactions in rare earth thin films; (3) laser research; (4) superconductivity of niobium; (5) dislocation contrast and dislocations in semi-infinite region; (6) microcreep of molybdenum crystals; (7) mechanical properties of molybdenum single crystals; (8) X-ray and resistivity studies of transformations in Ti–V alloys; (9) limiting properties in hard sphere solids and harmonic crystals; (10) kinetics of oxidation of nickel; (11) high temperature interactions between gases and condensed phases; and (12) crystal structure of complex molecules. N.E.A.

N65-27119# RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.

RESOLVING POWER OF FOCUSSING SYSTEMS WITH COHERENT ILLUMINATION

A. I. Carswell and C. Richard Apr. 1965 36 p refs

(Contract PD69-400007)

(RCA Res. Rept.-7-801-36)

Effects of the coherence properties of the source on the resolving power of a focussing system are considered. Computations are presented which illustrate the variations in the focal plane intensity distribution of a focussed system for source points emitting incoherently and for source points emitting coherently with different relative phases. Experimental results for a microwave system operating at 34.5 Gc (8.7 mm wavelength) are compared with the theoretical predictions and good agreement is found. With coherent source points, the effects of the secondary maxima (side lobes) in the diffraction pattern are shown to be much more pronounced than with incoherent source points. A simple criterion for the resolving power of coherent systems is suggested as an extension of the Rayleigh criterion used for incoherent sources. Author

N65-27151# McGill Univ., Montreal (Quebec).

ATTENUATION OF A PARALLEL BEAM OF LIGHT, PARTICULARLY BY SNOW Scientific Report No. 2

Olav Lillesaeter Apr. 1965 33 p refs

(Contract AF 19(628)-2489)

(MW-43; AFCRL-65-241; AD-615383)

A pulsed light has been used in a conventional optical system with a nearly-parallel beam of light: divergence less than 0.1°. Attenuation measurements over a 123 m path were made in Montreal in the early months of 1964. Attenuation by falling snow appeared to be proportional to the rate of snowfall, and is obviously proportional to distance. The value found was approximately 18(db km^{-1})/(mmw hr^{-1}), using mmw to denote the millimetres of water to which the snow would melt. This value dropped from 18 to 10 for wet snow and snow pellets. Attenuation by rain was only 0.25(db km^{-1})/(mm hr^{-1}). Observed visual range in snow varied inversely as the rate of snowfall, and was 1 km when the rate was 1 mnw hr^{-1}. Fluctuations noted in the received signal could be related to thermal eddies near the transmitter, and these are considered, along with laser possibilities, in an appendix. Author

N65-27235 Joint Publications Research Service, Washington, D. C.

MODES OF QUANTUM OPTICAL RESONATORS WITH DIELECTRIC FILLING

A. N. Orayevskiy and V. A. Shcheglov *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 100–113 refs (See N65-27225 16-34) CFSTI: $6.00

A study of the electrodynamic properties of open resonators filled with matter is reported. Data on the modes of plane and cylindrical dielectric resonators in the optical band are presented. Transverse wave numbers and resonance frequencies were calculated and the Q-factors of the modes determined. The density of spectral lines was determined within a given spectral interval Δ_ω. S.C.W.

N65-27237 Joint Publications Research Service, Washington, D. C.

NONRESONANT RADIOWAVE ABSORPTION IN MOLECULAR OXYGEN

K. S. Stankevich *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 124–132 refs (See N65-27225 16-34) CFSTI: $6.00

A part of the theory of radiowave absorption in molecular oxygen concerning the nonresonance absorption given by Van-Vleck is criticized. A mechanism is proposed permitting the explanation of the nonresonant absorption. Absorption of radiowaves by two-level paramagnetic gas molecules in presence of spin-interactions during collisions is discussed using the perturbation method. An expression for the absorption coefficient is also obtained. Author

N65-27248 Joint Publications Research Service, Washington, D. C.

THE RADIATION OF A SURFACE WAVE BY A CHARGE PASSING THROUGH THE INTERFACE OF TWO MEDIUMS

V. Ya. Eydman *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 248–252 refs (See N65-27225 16-34) CFSTI: $6.00

Presented is a theoretical analysis of the radiation of a surface wave by a charge passing through the interface between a vacuum and a medium with a substantial dielectric constant $\epsilon(\omega)$. Assuming that $\epsilon(\omega) < -1$ in a certain range of frequencies, expressions were derived for calculating the component of the electric field parallel to the trajectory of a particle in the medium; the field in the surface wave, and the energy losses of the charge due to radiation of the surface wave. It is shown that in the case of a relativistic velocity of the particle, the radiation energy of the surface wave constitutes only a small addition to the radiation energy emitted forward. Also, for frequencies with $\epsilon(\omega) < -1$, the radiation of the surface wave is determined in the losses of energy by the moving charge. S.C.W.

N65-27250 Joint Publications Research Service, Washington, D. C.

THE RADIATION OF A BEAM MOVING OVER A DIFFRACTION GRATING LYING ON A SHIELDED DIELECTRIC

E. I. Chernyakov *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 256–259 refs (See N65-27225 16-34) CFSTI: $6.00

Presented is a theoretical analysis of the radiation of electromagnetic oscillations by a monochromatic beam during its movement over a diffraction grating (metallic) located on a shielded dielectric. Determined were values relating to the region over the grating (I) and values relating to the region filled with the dielectric (II). Results show that in region-I the radiation represents a superposition of dense waves coming from the grating, and in region-II it is analogous to the system of waves propagated between two parallel planes with dielectric filling. It is noted that, in contrast to the case of a grating with a free space, radiation under the specified conditions is possible at positive spatial harmonics. S.C.W.

N65-27281# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Freiburg (West Germany). Institut für Angewandte Mathematik und Mechanik.

ON THE MAXIMUM PROBLEM FOR NONCONCAVE QUADRATIC FUNCTIONS [UBER DAS MAXIMUM-PROBLEM FÜR NICHTKONKAVE QUADRATISCHE FUNKTIONEN]

K. Ritter Mar. 1965 90 p refs In GERMAN; ENGLISH summary

(DLR-FB-65-17; DVL-385) Available from Zentralstelle für Luftfahrtdokumentation und Inform. (ZLDI), Munich: 21,60 DM

The subject of this investigation is to determine the absolute maximum of a nonconcave quadratic function in a convex polyhedron. Necessary conditions for a feasible point to constitute the solution to the problem are the KUHN-TUCKER conditions. Points satisfying the KUHN-TUCKER conditions are called "stationary points". Stationary points may be relative extremes or saddle-points. Criteria are given to classify

stationary points. The behavior of a stationary point during parallel shifting of its incident hyperplanes is also investigated. If the number of these hyperplanes changes, there need not exist a "continuation" of the stationary point. Conditions are stated under which a continuation exists, and the character of the stationary point is maintained. Using the obtained results, a method for determining the absolute maximum is described. Author

N65-27291# Northwestern Univ., Evanston, Ill. Technological Inst.

A RHEOLOGIC INVESTIGATION OF THE DYNAMIC RESPONSE SPECTRA OF SOILS. ENERGY DISSIPATION RESPONSE OF A COHESIVE SOIL

Robert L. Kondner and Michael M. K. Ho Jun. 1964 261 p refs

(Contract DA-22-079-ENG-316)

(Rept.-3; AD-613071)

The results of an investigation of the energy storage and energy dissipation properties of a cohesive soil are presented. Major emphasis is directed at energy dissipation as well as phenomena associated with energy dissipation. Soil response is represented in terms of viscoelastic parameters. Both direct and indirect methods of determining energy dissipations are considered. Damping capacity as a function of frequency is determined directly by measuring the phase angle, δ, between applied and resulting waveforms in uniaxial (unconfined) compression with controlled sinusoidal vibration. The results are given in terms of the loss tangent, tan δ. The loss tangent is dependent on moisture content, frequency, and amplitude of dynamic stress–strain; but specimen geometry and static stress level, within the range considered seem to have no definite effect on the results. The experimental response is definitely nonlinear. Energy dissipation is also obtained by indirect methods through the application of Fourier transformation techniques to experimental data obtained from creep and stress relaxation tests. Such transformations are made using piecewise continuous approximations of the creep and relaxation response in association with digital computer techniques. The loss tangent relations obtained using the Fourier Transforms are comparable to those obtained by the direct stress–strain-phase angle method. A review of previous studies on wave propagation and attenuation as well as the electrical analog to rheologic systems is also given. Author

N65-27336# Central Lab. TNO, Delft (Netherlands).

CHOICE OF MOST SUITABLE RADIATION CHARACTERISTICS FOR ANY GIVEN GAUGING PROBLEM

P. Platzek and A. C. Meyer Brussels, EURATOM, 1965 17 p refs Presented at 3rd Intern. Conf. on the Peaceful Uses of Atomic Energy, Geneva, 31 Aug.–9 Sep. 1964

(Contract EURATOM-002-62-12-IRAN)

(EUR-2221.e) Available from Belg. Am. Bank and Trust Co., New York Account No. 22.186: 40 Belg. Fr.

Gauging mostly aims at detection or measurement of mass differences, rather than at determination of an average mass as such. In this respect level indication may be considered as a gauging problem as well, in addition to thickness- or density (difference!) measurements. A mass deviation ΔX from average mass X must be detected or measured by means of a signal difference ΔN significantly larger than possible statistical signal fluctuations. When secondary effects as heterogeneity of radiation, scattering, source dimensions, detector response etc. are neglected, β- as well as γ-radiation can in first approximation be supposed to obey the same exponential attenuation law. Simple theoretical considerations then show that the average object mass alone determines the choice of an optimum radio-isotope (e.g. mass attenuation coefficient of principal radiation). In consequence, the required source strength depends on: 1. minimum mass difference to be detected (Δx); 2. accuracy wanted ($\Delta N/\sqrt{N_x}$); 3. measuring time t; and 4. geometry and detector efficiency. On the ground of the assumption that $\Delta N/\sqrt{N_x}$ should at least be equal to 5, a graph has been constructed to read the required signals for optimum as well as for non-optimum conditions. Experimental data show to which extent the simplifying assumptions are valid. Author

N65-27381*# Maryland Univ., College Park. Computer Science Center.

ON DISCRETIZATION AND DIFFERENTIATION OF OPERATORS WITH APPLICATION TO NEWTON'S METHOD

James M. Ortega and Werner C. Rheinboldt May 1965 25 p refs

(Grant NsG-398)

(NASA CR-63634; TR-65-16) CFSTI: HC $1.00/MF $0.50 CSCL 12A

In the numerical solution of operator equations $Fx = 0$, discretization of the equation and then application of Newton's method results in the same linear algebraic systems of equations as application of Newton's method followed by discretization. This leads to the general problem of determining when the two frequently used operations of discretization and (Frechet) differentiation applied to a non-linear operator are commutative. A theory of discretization processes is developed here which proves that for a wide class of operators of interest in applications, discretization and differentiation indeed "commute". The fundamental concept of the theory is a distinction between the discretization of the linear spaces involved and the replacement of the infinitesimal parts of the operator F, i.e., those parts involving, e.g., differentiation and integration, by a discrete analogue. Using this distinction in an abstract way a "complete" discretization process is defined precisely and the cited commutativity results are proven. The results are then applied to Newton's method. Author

N65-27552# Cincinnati Univ., Ohio.

PREDICTING EQUILIBRIUM PRESSURES FROM TRANSIENT PRESSURE DATA Interim Report, Feb.–Aug. 1964

David L. Brown Wright-Patterson AFB, Ohio, ARL, Jan. 1965 43 p refs

(Contract AF 33(616)-8453)

(ARL-65-7; AD-614819)

It was the purpose of this study to investigate the time-lag phenomena associated with wind tunnel pressure measurements, and find a method for predicting the equilibrium pressure from the transient pressure conditions. In order to do this a mathematical model of the actual physical case was formulated. Actual transient pressure data was fitted by least squares to this model and the equilibrium pressure predicted. Author

N65-27559# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BASIC FACTORS DETERMINING THE RESOLVING POWER OF PHOTOGRAPHIC MATERIALS

G. G. Gribakin and G. A. Istomin 7 Apr. 1965 8 p refs Transl. into ENGLISH from Zh. Nauch. i Priklad. Fot. i Kinematografii (Moscow), v. 9, no. 1, 1964 p 57–59

(FTD-TT-65-293/1+2; AD-614763)

An equation is derived which describes the resolving power of photographic materials of diffusion of light by the emulsion layer, the contrast coefficient, and granularity of the photographic density. TAB

N65-27579# TRG, Inc., Melville, N. Y.
RESONANCES IN THE SPECTRAL ENERGY DENSITY OF THERMAL FIELDS AND SPONTANEOUS EMISSION Scientific Report No. 5
Stephen R. Barone Mar. 1965 32 p refs *Its* Rept.-160-SR-5
(Contract AF 19(604)-8817)
(AFCRL-65-228; AD-614061)

The two-point correlation functions for a thermal field in an arbitrary geometric environment are evaluated in terms of the spectral density of the classical electromagnetic Green's function for the configuration. The utility of this representation is demonstrated by a calculation of the electric and magnetic spectral energy densities in the vicinity of a plane mirror and in an infinite aperture Fabry-Perot interferometer. Secondly it is shown how the rate and character of spontaneous emission in an arbitrary geometric environment can be extracted from the spectral energy density for a thermal field in that environment. Spontaneous magnetic dipole transitions in the above two geometric configurations are discussed in detail.
Author

N65-27588# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMMENTS ON THE EFFECT OF A DEFORMED, PLANE PARALLEL GLASS PLATE IN THE IMAGE PLANE OF AN OBJECTIVE ON ITS DISTORTION
W. Dannberg and G. Wuertz 26 Apr. 1965 12 p refs Transl. into ENGLISH from Volkseigener Betrieb Carl Zeiss Jena (East Germany).
(FTD-TT-65-249/1+2; AD-614401)

Methods for computing optical compensation plates in the case of oblique image observation. Advantages and drawbacks of the methods under discussion are explained by way of a practical example.
Author

N65-27590# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
PHOTOELASTICITY—PRINCIPLES, METHODS, AND APPLICATIONS TO MATERIALS TESTING, METALLURGY AND MECHANICS, PARTS I, II, AND III
Pierre Laurent and A. Popoff Mar. 1965 149 p refs Transl. into ENGLISH from Rev. Met. (Paris), v. 35, 1938, no. 8, p 363–378; no. 9, p 407–424; no. 10, p 448–474
(RSIC-388; AD-614282)

The practical utility of photoelasticity was proved experimentally. The results obtained optically agree with the values found by other methods on metal pieces. Nevertheless, despite the service already rendered by photoelasticity, some persons are reluctant to use it, considering it a delicate, difficultly interpretable method, and, especially, an expensive method. The use of synthetic resins had considerably modified the method, while preserving its precision. With these resins the cost price of a model is insignificant.
TAB

N65-27631# Space Technology Labs., Inc., Redondo Beach, Calif.
THE ULTRAVIOLET ABSORPTION SPECTRA OF CALCIUM, STRONTIUM, AND BARIUM
R. D. Hudson and P. A. Young (Univ. of Southern Calif.) Aug. 1963 79 p refs
(STL-9803-6004-RU-000)

The absorption cross section values obtained for strontium showed a sharp rise of the absorption continuum at 2177.4 Å to a peak value of 3.6×10^{-18} cm^2 and a subsequent slower fall to zero before the onset of the absorption to doubly excited states. The oscillator strength for the ionization continuum and for the strongest autoionization lines of strontium were calculated. In the interval between the series limit of the normal series at 2177.4 Å and the first excited state of the strontium ion, which lies at 60481 cm^{-1} above the ground state of the atom, 36 lines were observed. The wavelengths of these lines were measured on the traces obtained and the mean values with the corresponding wave numbers are given. An energy level diagram is presented for strontium which shows the new levels of the autoionized series discovered and the selection of the energy levels previously reported.
E.E.B.

N65-27638# Army Missile Command, Huntsville, Ala. Solid State Physics Branch.
PHYSICAL QUANTUM ELECTRONICS. PART I: FIELD THEORETICAL FOUNDATIONS
C. Alton Coulter (Alabama Univ.) and B. M. Morris (Tennessee Univ.) 26 Feb. 1965 94 p
(RR-TR-65-2; AD-465095)

Graduate-level lectures abstracted here deal with the fundamentals of nonrelativistic quantum field theory. A review of the Heisenberg and Schrödinger pictures in ordinary quantum mechanics and a development of the second-quantization formalism is given. Operator fields with appropriate boson and fermion equal-time commutation relations are introduced, and details of the mathematical representation and physical interpretation are worked out for the case of noninteracting particles. The theory is extended to embrace two-body particle-conserving interactions, and particle-nonconserving interactions are treated. The method for obtaining alternative forms of the theory by expanding the field operators in terms of complete orthonormal sets of functions is discussed. The integral equation of motion in the interaction picture is developed, and its solution is obtained by successive approximations. The Dyson chronological operator is defined. Examples of time-independent and time-dependent perturbation theory in the interaction picture are given. Ordinary and chronological contractions of operator products are defined, and the use of Wick's theorem in an evaluation of the perturbation expansion for the ground state energy of a system of interacting fermions is described. The representation of the perturbation expansion by Goldstone diagrams is explained.
Author

N65-27849# P. E. C. Corp., Boulder, Colo.
SINGLE OPTIMUM SPACE-TIME REFERENCING SYSTEM Final Report
Saul A. Basri and Willard C. Humphreys Feb. 1965 62 p refs
(Contract AF 19(628)-3997)
(AFCRL-65-159; AD-615980)

This study develops methodologies for coordinate fixing from measurements made on board a space craft in midflight. Both the problems of locations of the craft itself and location of events outside the craft are considered and a unified treatment of both problem areas is given. An error-minimization strategy is presented for the selection of reference frame in which to express the vehicle's position. The main purpose of this work is to investigate and solve the problems met in the positioning and description of motion objects within the solar system. It is found that the deflection in direction by an electromagnetic signal and corrections to angular measurement by means of such signals due to the presence of matter, are negligible within the solar system, except in the neighborhood of the sun.
Author

N65-27860# Pennsylvania Univ., Philadelphia.
STUDIES IN THE THEORY OF PARTIAL COHERENCE Final Report
Mark Beran [1965] 10 p refs
(Grant DA-ARO(D)-31-124-G331)
(AROD-3734-11; AD-464888)

Summaries of statistical studies on the properties of electromagnetic fields are presented. Included are discussions on the coherence properties of radiation emitted by turbulent gases, statistical properties of static electric fields in heterogeneous materials, probability density functionals and higher order coherence functions, and quantum aspects of the measurement of coherence functions. R.N.A.

N65-27867# Naval Weapons Lab., Dahlgren, Va. Warhead and Terminal Ballistics Lab.

AN EVALUATION OF THE HIGH-LOW BALLISTIC PRINCIPLE FOR CARTRIDGE ACTUATED DEVICES

S. E. Hedden, J. M. Massey, Jr., and P. N. Stamoulas 6 Apr. 1965 55 p
(NWL-1964; AD-464452)

By designing cartridge actuated devices on the high–low ballistic principle a number of design problems are alleviated. If sonic flow is maintained through the orifice, the cartridge can be fabricated and tested as a discrete assembly. The device can be designed on the basis of a predetermined gas input profile. Optimum burning pressure can be assured for the propellant. A single cartridge may be used to launch a wide range of loads from a single device. Appreciable "heat-losses" occur in the low chamber which significantly reduce the overall efficiency of the high–low system. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-26680 Varian Associates, Beverly, Mass.

FACTORS WHICH LIMIT THE ACCURACY OF CESIUM ATOMIC BEAM FREQUENCY STANDARDS

J. H. Holloway and R. F. Lacey *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 317–331 refs (See N65-26657 16-14)

The principal sources of error in a cesium atomic beam frequency standard are associated with distortions in the uniform magnetic field in the transition region, the characteristics of the microwave structure used to excite the atomic resonance, the nature of the microwave spectrum applied to the beam tube, and neighbouring atomic transitions. Detailed analysis has been carried out for many of these distortions in an attempt to find what limits of accuracy may be anticipated for such standards. The analysis for the most important distortions will be summarized. Methods for measuring the effects of some of the distortions and for estimating correction factors will be discussed. It is shown that for practical standards which approach the limiting accuracy, a high beam strength is required. Several multipole and dipole beam optics systems have been studied, in order to select a design which achieves high beam intensities and utilizes the cesium efficiently. The design and calculated performance for such a high intensity will be presented. Finally, experimental measurements of some characteristics of existing cesium beam standards will be given. Author

N65-26683 Brussels Univ. (Belgium). Laboratoire des Etalons de Frequence.

DISCUSSION OF METHODS OF DETECTION OF ATOMIC AND MOLECULAR JETS [DISCUSSION DES METHODES DE DETECTION DE JETS ATOMIQUE ET MOLECULAIRES]

J. C. Lievin, S. T. Haume, J. De Prins, and J-L. Guisset *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 359–363 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

Two methods of detecting atomic or molecular beams, one involving detection by electron beams and the other by surface ionization of a hot filament, are reviewed briefly. The use of field ionization as a means of detection is proposed, based on the 'tunnel effect' by which an electron moves from a particle onto the detector. Trans. by J.M.D.

N65-26943# American Meteorological Society, Boston, Mass.

THE QUANTIZED LOSS OF VELOCITY BY SLOW ELECTRONS IN RAREFIED GASES [UBER DEN QUANTENHAFTEN GESCHWINDIGKEITSVERLUST LANGSAMER ELEKTRONEN IN VERDUNNTEN GASEN]

Helmut Löhner Jun. 1964 42 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), Ser. 5, 8 (1), 1930 p 50–86
(Contract AF 19(628)-3880)
(T-G-203; AD-461875)

Lenard retarding potential method was used to measure critical potentials and determine collision yields in analogy to Akesson's procedure. This principle applied to the construction of two apparatus with different degrees of beam definition which constituted improvements in Akesson's procedure. The critical potentials of gaseous H_2, N_2, and CO_2 were derived from the measured step widths and were compared with Akesson's earlier values. The potentials found in argon agrees with the excitation potentials known from other electrical and optical measurements. The probability of velocity loss without substantial deflection was computed from the step heights for both apparatuses and compared with Akesson's data. The collision yield was computated and the emergency and upward trend on the yield-function curve was discussed in its relation to the curve of the effective cross section. N.E.A.

N65-26971# Research Inst. of National Defence, Stockholm (Sweden).

A NEW METHOD FOR PREDICTING THE PENETRATION AND SLOWING-DOWN OF NEUTRONS IN REACTOR SHIELDS

L. Hjärne and M. Leimdörfer Jan. 1965 25 p refs
(A-4410-411)

A new approach is presented in the formulation of removal-diffusion theory. The "removal cross-section" is redefined and the slowing-down between the multi-group diffusion equations is treated with a complete energy transfer matrix rather than in an age theory approximation. The method, based on the new approach, contains one adjustable parameter which seems to be universally constant. Examples of neutron spectra and thermal flux penetrations are given in a number of differing shield configurations and the results compare favorably with experiments and Moments Method calculations. Author

N65-26974# European Atomic Energy Community, Brussels (Belgium).

ANALYSIS OF NEUTRON SPECTRUM IN CANDU TYPE LATTICE

H. Takahashi Nov. 1964 21 p refs
(EUR-1849.e)

Neutron spectra in CANDU type lattice are analysed by the first flight collision probability (F.F.C.P.) method, using

the free gas model, the Brown-St. John's model and the Nelkin-Honeck's model for the neutron scattering by D_2O. Applicability of F.F.C.P. method to a loosed lattice such as the CANDU lattice is firstly discussed, it is shown from the comparison of various scattering models that the chemical binding plays a very important role in analysis of the neutron spectrum of this type reactor, and the mass approximation for the chemical binding can not be applied, and that the neutron spectrum in fuel region in epithermal energy around 0.2 eV is quite sensitive to the scattering model. The effect of slowing down neutron on the hardening of neutron spectrum in fuel region is larger than the effect of the rethermalization (heating of neutron by hot coolant). Comparison of the calculated values of reaction rate with the experimental results of Bigham et al. shows that the agreement of two results in cold coolant is very good in the activation ratio of Lu-176 to Mn-55, but not in the case of hot coolant. The agreement of experimental and calculated values of fission ratios of Pu-239 to U-235 is rather good in hot coolant case but not in the cold coolant case. Author

N65-26980# Research Inst. of National Defence, Stockholm (Sweden).
GAMMA DOSE RATES FROM GROUND AND STEEL ACTIVATION FOLLOWING NUCLEAR FISSION EXPLOSIONS IN AIR
A. Bergström and M. Leimdörfer Nov. 1964 27 p refs
(A-4402-454)

A series of calculations has been made to display the expected activation gamma dose rate at the air-ground interface induced by neutrons from a nuclear burst in air under different conditions. The removal-diffusion technique was used for the neutron slowing-down calculation. The nuclear explosive was surrounded by varying effective thicknesses of the remainder of the initiating explosive (TNT), ranging from 0 to 50 cm. The burst altitude as well as the ground water contents were also varied, the former from 100 to 1500 m and the latter from 0 to 50 percent by weight. The results are split up to give separately the dose rate contributions from activated Na, Mn, and Al nuclei. Thermal neutron fluxes are also presented for a number of illustrative cases. A supplementary calculation was made to analyse the gamma dose rate contributions from a steel slab on the ground. Author

N65-26990# Princeton Univ., N. J. Elementary Particles Lab.
EXPERIMENTAL MEASUREMENT OF THE ELECTROMAGNETIC FORM FACTOR OF THE NEGATIVE π MESON
Technical Report, Jun. 1962–Dec. 1965
David G. Cassel (Ph.D. Thesis) 10 Feb. 1965 84 p refs
(Contract Nonr-1858(06))
(TR-37; AD-461353)

The scattering of π mesons of 21 BeV energy, incident on electrons at rest was studied in order to determine the electromagnetic form factor of the π meson. The results of an analysis of 4% of the data obtained in the experiment are consistent with a point charge model for the π meson. The data place an upper limit on the root mean square radius due to charge structure effects and radiative effects of $R = 3.3$ f. This limitation on the radius is to be interpreted as a limitation on the absolute value of the slope of the form factor at $t = o$. These data do not exclude positive slopes at the origin corresponding to an imaginary value of the radius of the same magnitude. Author

N65-26999# Oak Ridge National Lab., Tenn. Radiation Shielding Information Center.
BIBLIOGRAPHY, SUBJECT INDEX, AND AUTHOR INDEX OF THE LITERATURE EXAMINED BY THE RADIATION SHIELDING INFORMATION CENTER
S. K. Penny, D. K. Trubey, and M. B. Emmett Mar. 1965 561 p refs Supersedes ORNL-RSIC-2
(ORNL-RSIC-5; ORNL-RSIC-2)

N65-27022# Argonne National Lab., Ill.
REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP
A. B. Smith, comp. [1965] 149 p refs Meeting held at Natl. Bur. of Standards Gaithersburg Lab. and AEC, Wash., D. C., 8–9 Mar. 1965
(WASH-1056) CFSTI: $4.00

Recent developments, changes of emphasis, and preliminary data on nuclear cross sections are presented in brief abstracts covering the work of the laboratories relating to nuclear cross section measurements. E.E.B.

N65-27039# European Atomic Energy Community, Brussels (Belgium).
KINETIC THEORY AND CALCULATIONS IN A FEW-ENERGY-GROUP TWO-SPACE-POINT MODEL FOR A FAST REACTOR PERIODICALLY PULSED BY REACTIVITY VARIATIONS
T. Asaoka and R. Misenta 1965 37 p refs
(EUR-2273.e) Available from Belg. Am. Bank and Trust Co., New York Account No. 22.186: 60 Belg. Fr.

A simple multigroup two-space-point kinetic theory has been developed in order to obtain accurately the characteristics of stationary pulses of a periodically pulsed fast reactor which contains water-scatterers in the reflector. The energy division aims at separating slow neutrons with lifetimes comparable to the pulse width ($\sim 50/\mu$sec) from fast neutrons. In addition to this, the space division is required to obtain especially the pulse characteristics of the thermal flux in the water-scatterer. A comparison of the numerical results obtained from this two-space-point model with those of the previously used one-point model shows that it is necessary to treat the core and scatterer separately, even for analysing the pulse characteristics in the core. In addition, the calculation shows that an insulation of the core from intermediate as well as thermal neutrons produced in the scatterer is required, in order to obtain a high pulse amplitude in the fast group of the core and in the thermal group of the scatterer. Author

N65-27045# Research Inst. of National Defence, Stockholm (Sweden).
A MONTE CARLO PROCEDURE FOR CALCULATING THE MIGRATION OF PROTONS TAKING ACCOUNT ONLY OF ELECTROMAGNETIC INTERACTIONS
C. Johansson and M. Leimdörfer Jan. 1965 18 p refs
(A-4411-411)

The present report describes a method by which one can study the penetration and slowing-down of protons due to proton-atom interactions of non-nuclear type. A "continuous slowing-down" model has been applied which moves the protons down in energy between a set of predefined energy points. A sample result shows the expected energy distribution of

187 MeV protons after penetrating aluminum slabs of various thicknesses. The calculations are presently being checked at the cyclotron at Uppsala University. Author

N65-27047# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
APPLICATION OF THE DASHEN-FRAUTSCHI METHOD TO THE CALCULATION OF THE DIFFERENCE BETWEEN THE nn AND np SINGLET SCATTERING LENGTHS
H. Goldberg Jun. 1965 39 p refs
(TH-100)

The difference between the ^1S_o np and nn scattering lengths is calculated by a method due to Dashen and Frautschi. In the calculation the driving term used is the change in the one pion exchange contribution between the two channels due to differences in the charged and neutral pion masses which are exchanged, in the charged and neutral πN coupling constants, and in the external proton and neutron masses. The split in the coupling constants is also estimated with the same formalism, and constitutes an independent result. The overall result obtained is $a_{nn}-a_{np} = -3.6 \pm 3.4F$, if the elementary particle physics definition of scattering length is used. This is in qualitative agreement with recent experimental findings. Author

N65-27065# European Atomic Energy Community, Brussels (Belgium).
THE CORRECTION FOR FOIL ABSORPTION IN 4 π COUNTING
W. van der Eijk 5 Jan. 1965 30 p refs
(EUR-2248.e) Available from Belg. Am. Bank and Trust Co., New York Account No. 22.186; 50 Belg. fr.

Experimentally determined corrections for the foil absorption in 4 π-counting are presented for several radionuclides in current use. A discussion of the precision and the limits of applicability as well as short discussion of the theoretical aspects of the problem are included. Author

N65-27105# Research Inst. of National Defence, Stockholm (Sweden).
A USER'S MANUAL FOR SALOMON, AN IBM-7090 CODE FOR GAMMA TRANSPORT CALCULATIONS
G. Engstrom Nov. 1964 19 p refs
(A-4403-411)

SALOMON is a FORTRAN program that utilizes the Monte Carlo technique to treat gamma transport problems in multislab one-dimensional plane geometry. The present report describes the preparation of input data and gives some other information of essence to the user. Author

N65-27109# Argonne National Lab., Ill. Industrial Hygiene and Safety Div.
ENVIRONMENTAL RADIOACTIVITY AT ARGONNE NATIONAL LABORATORY, REPORT FOR 1962 AND 1963
J. Sedlet and F. S. Iwami Jan. 1965 65 p refs
(Contract W-31-109-ENG-38)
(ANL-6945) CFSTI: $3.00

The results of the environmental monitoring program at the laboratory during 1962 and 1963 are presented. Radiochemical analyses, total activity measurements, and gamma-ray spectrometric measurements were performed on several types of natural materials collected on the site and its surrounding locations, and the total activities in samples of water, material from lake and stream beds, soil, air, and plants are shown. The outstanding feature in the environmental radioactivity was the relatively high level of fallout activity resulting from USSR tests in 1961 and 1962, and the US tests in 1962, which resulted in sharp increases of the Sr^{89}/Sr^{90} ratio as well as an increase in the Sr^{90} concentrations of local dairy milk. G.G.

N65-27118# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
REMARKS ON THE QUANTUM KINEMATICS OF THE ANGULAR MOMENTUM OF A PARTICLE
Jean-Marc Levy-Leblond May 1965 13 p refs
(TH-96)

The quantum kinematics of the angular momentum of a particle as studied by Moses and Wang is discussed. It is shown that the problem considered previously can be solved in a simpler manner which permits a simple closed analytical expression for the various probabilities to be computed. This is accomplished by using an irreducible representation of the Poincare group to construct a concrete angular momentum basis. E.E.B.

N65-27121# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ON THE GROUND-STATE OF LIQUID AND SOLID HELIUM 4 AT ZERO TEMPERATURE
Dominique Levesque, Daniel Schiff, Tu Khiet, and Loup Verlet Jun. 1965 24 p refs
(TH-99)

A variational calculation is made of the ground-state energy of a system of helium 4 atoms interacting by a Lennard–Jones potential, at absolute zero and in a range of densities covering both the liquid and the solid region. Author

N65-27162# Naval Ordnance Lab., White Oak, Md. Air-Ground Explosions Div.
ONE-DIMENSIONAL HYDRODYNAMIC CODE FOR NUCLEAR-EXPLOSION CALCULATIONS
Delbert L. Lehto and Morton Lutzky Mar. 1965 73 p refs
(NOLTR-62-168; DASA-1518; AD-615801)

A one-dimensional hydrodynamic finite-difference computer code (WUNDY), which evolved from the M. Wilkins KO-CODE of the University of California Radiation Laboratory, is described and applied to the calculation of the shockwave from a nuclear explosion. FORTRAN IV listings are given. Author

N65-27213# RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND A REFORMULATION OF THE INTERNAL INTENSITY PROBLEM IN TRANSPORT THEORY
R. E. Bellman, H. H. Kagiwada, and R. E. Kalaba Apr. 1965 22 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4539-PR; AD-614031)

Modern electronic computers can integrate in the order of one thousand simultaneous nonlinear ordinary differential equations, given a complete set of initial conditions. One of the aims of the theory of invariant imbedding is to show how to use this capability to resolve significant problems in transport theory. In the present paper the authors show how to compute internal intensities when a finite homogeneous slab is illuminated by uniform parallel rays of radiation. It is assumed that there is absorption and isotropic scattering in the slab. Author

N65-27223# European Atomic Energy Community, Brussels (Belgium).
ON A MULTIGROUP KINETICS

D. Schwalm Mar. 1965 49 p refs
(EUR-2285.e) Available from Belg. Am. Bank and Trust Co., New York Account No. 22.186: 70 Belg. Fr.

For a pulsed fast reactor with H_2O scatterers the lifetime spectrum contains an appreciable component with lifetimes of the same order of magnitude as the pulse width. Thus, a onegroup theory will give a mean lifetime which is not small compared to the reactivity pulse width, and it is therefore wrong to describe the kinetic behaviour of the reactor with only one group. For this reason, an extension of the method of GOERTZEL to many groups was carried out and applied to the SORA reactor. In particular, the problem of stationary pulses has been studied. Author

N65-27272*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF GRYZINSKI'S AND BORN'S APPROXIMATIONS FOR INELASTIC SCATTERING IN ATOMIC HYDROGEN
Carl F. Monnin and George M. Prok Washington, NASA, Jun. 1965 23 p refs
(NASA-TN-D-2903) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Excitation cross sections for electron scattering in atomic hydrogen were determined by the Born approximation from the ground state to all excited states up to the 4f level. Gryzinski's semiclassical theory was used to obtain similar cross sections. Because of the small differences in energy between various energy levels of a principal quantum level, however, only the sum of cross sections for all transitions to the principal quantum level can be determined. Results of this method were compared with the sum of the individual sublevel cross sections determined by the Born approximation. Cross sections are presented for transitions from the ground state to n = 2, 3, 4, and ionization. The theoretical cross sections are compared with the experiment for the $1s \rightarrow 2s$, $1s \rightarrow 2p$, and $1s \rightarrow$ ionization transitions. In addition, calculations of Gryzinski's electron exchange cross section were performed for the 2s, 3s, and 4s levels. Gryzinski's theory gave lower excitation cross sections than Born's approximation for all transitions up to n = 4 and for ionization. In the energy range considered (threshold to 360 eV), the cross sections resulting from the two theories are quite similar in shape and differ at various electron energies by a factor between 2 and 4. The exchange cross section of Gryzinski agrees very well with experiment for the $1s \rightarrow 2s$ transition below 40 electron volts. Author

N65-27274*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EMPIRICAL EQUATIONS FOR ELECTRON BACK SCATTERING COEFFICIENTS
Kenneth F. Koral and Allan J. Cohen Washington, NASA, Jul. 1965 18 p refs
(NASA-TN-D-2909) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Empirical equations were obtained for electron backscattering coefficients in the energy range 0.6 to 1.8 MeV. These equations give normal-incidence back-scattering coefficients and approximate angular-incidence backscattering coefficients as functions of thickness, atomic number, and energy. Materials involved were metals with atomic numbers ranging from 13 to 79. Additional data are presented to allow extrapolation of the formulas to include incident energies between 5.0 keV and 3.0 MeV. By using the empirical equations, an upper limit was calculated for the fraction of electrons backscattered from the collector to the emitter of a beta radioisotope cell. For the particular proposed design considered, the upper limit indicated that electron backscattering from the collector would cause, with the proper material, only moderate efficiency losses in the cell. Author

N65-27326 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ELASTIC AND INELASTIC ELECTRON SCATTERING
M. Gourdin [1965] 5 p refs

In the one photon exchange approximation, the angular distribution of the electrons in elastic electron-scattering can be written as the product of the Mott cross section by a linear function of $tg^2\,\Theta/2$, where Θ is the laboratory scattering angle

$$\frac{d\sigma}{d_{\sigma Mott}} = A(q^2) + B(q^2)\,tg^2\,\Theta/2$$

and q^2 is the square of the energy momentum transfer. This formula was first given for the case of spin-1/2 particles but is quite general and is independent of the spin vector $\vec{J}$ of the target. The two functions $A(q^2)$ and $B(q^2)$ depend on the electromagnetic form factors of the target. A general analysis is presented for A and B in terms of physical form factors. E.E.B.

N65-27364*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EQUATION OF STATE OF MATTER AT SUPERNUCLEAR DENSITY
E. R. Harrison 16 Apr. 1965 13 p refs
(NASA-TM-X-55223; X-640-65-170) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The nature of the equation of state of matter whose density exceeds that of ordinary nuclear matter (supernuclear density) is investigated. In particular, an earlier conclusion that as the supernuclear density increases in an isotropic fluid the pressure tends to equal the energy density, which is based on a simple model in which stationary baryons interact through a vector meson field, is shown to be unrealistic because it ignores the high energy of the baryons imposed by the exclusion principle. A further unsatisfactory feature of the model is that it singles out unit-spin mesons and neglects the rest of the meson multiplets. It is found, however, that if the potential equation in this model is used as a crude description of short-range interactions, it will yield a realistic equation of state. J.M.D.

N65-27402# India. Dept. of Atomic Energy, Bombay. Health Physics Div.
FISSION PRODUCTS DATA AND ITS APPLICATION IN STUDYING FALLOUT FROM NUCLEAR WEAPON TESTS
C. Rangarajan, U. C. Mishra, B. Y. Lalit, Sarada Gopalakrishnan, and S. Sadasivan comp. 1965 28 p refs
(AEET-209)

Data on relative concentrations of various fission products released in nuclear weapon tests are tabulated, listing the half-life, and beta and gamma energies of the important fission products in bomb debris; the percentage yields of fission products for thermal, fission spectrum, and 14-Mev neutrons for U^{237}, U^{235}, U^{238}, Th^{232}, and Pu^{239}; and the ratios of the activities of the important fission products. The data are useful in determining the mode of fission and the type of fissile material used in a nuclear weapon test. Increasing the neutron energy above thermal results in an increase in the probability of symmetric fission. For 14-Mev neutron fission the increase is about 100-fold, and for fission spectrum neutron fission the increase is only 4-fold. An increase of the mass number of the fissile material results in a shift in the left peak of the fission yield curve. By using these properties, suitable pairs of isotopes can be chosen so that their ratios differ significantly for the various modes of fission and fissile material likely to be of importance in nuclear weapons. The pairs of isotopes can also be used for dating the fission products being sampled, and for studying the change in composition of debris. L.S.

N65-27418# Atomic Energy Information Service, Frankfurt am Main (West Germany).
ACCELERATORS. SERIES C: BIBLIOGRAPHIES
W. Mausberg comp. Jan. 1965 109 p
(AED-C-18-04)

N65-27477 Maryland Univ., College Park.
THEORY OF THE LINE ABSORPTION COEFFICIENT
Hans R. Griem *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 11–12 refs Abstract and discussion of "Plasma Spectroscopy" Mc Graw, 1964 (See N65-27475 16-30)

A transcript of a brief discussion pertinent to Chapter 4 in *Plasma Spectroscopy* is presented. This chapter reviews the quantum theory of the line absorption profile, emphasizing pressure broadening by charged particles. The author of this book, H. R. Griem, answered questions on stellar line λ4471 and forbidden lines. J.M.D.

N65-27478 University Coll., London (England). Dept. of Physics.
THE EMISSION COEFFICIENT
D. G. Hummer *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 13–31 refs (See N65-27475 16-30)

The phenomenological derivation of the emission coefficient for a two-level atom is reviewed and the physical bases of the various assumptions are discussed. Author

N65-27479 University Coll., London (England). Dept. of Physics.
COLLISION CROSS SECTIONS
M. J. Seaton *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 33–46 refs (See N65-27475 16-30)

Methods of calculating electron–atom cross sections are reviewed and used in calculating theoretical values which are plotted against experimental results. Classical theory, Born equation, dipole, Coulomb–Born, scaling, and combined classical and dipole approximations are presented. J.M.D.

N65-27555# Defense Research Corp., Santa Barbara, Calif.
INTERACTION OF HIGH INTENSITY RADIATION AND MATTER Final Report, Oct. 1964–Mar. 1965
Peter Redmond 1 Apr. 1965 4 p
(Contract DA-31-124-ARO(D)-94)
(AROD-4157-4; AD-614615)

Investigations on the refractive index of a relativistic plasma and the solution of the Schrodinger equation for a particle in a harmonic oscillator well in the presence of a uniform static magnetic field and a uniform time-dependent electric field are reported. When intense radiation is propagating through a plasma, there will be nonlinear effects produced by the $\vec{v} \times \vec{B}$ term in the interaction. These effects can be treated exactly for suitably idealized models of the plasma. For many systems the unperturbed motion of the particles is well described by a harmonic oscillator. If the radiation is incident on such a system in the presence of a magnetic field, and if the radiation field is treated using the dipole approximation, then the problem reduces to the Schrodinger equation for a particle in a harmonic oscillator well in the presence of a uniform static magnetic field. E.E.B.

N65-27563# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.
FORMULATION OF RADIATION TRANSPORT SOLUTIONS FOR SHIELDING APPLICATIONS, INCLUDING INTEGRAL TRANSFORM METHODS, MATRIX TECHNIQUES, AND ASYMPTOTIC APPROXIMATIONS
J. M. Norwood and R. E. Beissner Kirtland AFB, N. Mex., AF Weapons Lab., Mar. 1965 84 p refs
(Contract AF 29(601)-6213)
(WL-TR-64-151; AD-614250)

The objective of this study is to develop new and improved computational models for the determination of radiation intensity behind bulk shields and to provide further insight into radiation transport phenomena. A study of integral transform methods as applied to the neutron transport equation in finite geometrics under the spherical harmonics formulation is presented, representative problems are treated in slab, spherical, and cylindrical geometries. A matrix-integral-operator solution in slab geometry is included. The results of a study of an asymptotic method of obtaining angular distributions behind bulk shields are presented and the problem of electron transport in the 1- to 5-Mev range is discussed. Author

N65-27571# India. Dept. of Atomic Energy, Bombay. Chemical Engineering Div.
SEPARATION OF NEON ISOTOPES BY THERMAL DIFFUSION, I
S. Raman, T. K. S. Narayanan, and S. M. Dave 1965 22 p refs
(AEET-204)

The thermal diffusion factor for neon has been determined at the mean temperature of 243° K, using a glass swing separator. "A comparison" with the literature data and theoretical values has been done. Author

N65-27572# India. Dept. of Atomic Energy, Bombay. Chemical Engineering Div.
SEPARATION OF NEON ISOTOPES BY THERMAL DIFFUSION, II
S. Raman, T. K. S. Narayanan, and S. M. Dave 1965 21 p refs
(AEET-205)

The performance of a hot-wire thermal diffusion column is discussed. It has been found that equilibrium is approached within an hour with neon. Maximum separation is obtained in this column at a pressure of 42 cms. of mercury. Use of two spacers to centralise the hot-wire increases the separation. Author

N65-27573# India. Dept. of Atomic Energy, Bombay. Health Physics Div.
MEASUREMENTS OF AIRBORNE RADIOACTIVE FALLOUT IN INDIA
C. Rangarajan, Sarada Gopalakrishnan, S. Sadasivan, and P. V. Chitale 1965 36 p refs
(AEET-208)

The results of the measurements made in India on fission product activity in the air at ground level for the different sampling stations have been summarised. The measurements include the total beta activity in the air as well as the activity of specific radionuclides, estimated by gamma spectrometry. The tracer isotope Mn-54 released in the 1961 autumn tests is also measured. The seasonal variations in activity observed at Bombay and other stations are also discussed. A study of the Mn-54/Cs-137 ratio indicates the possible arrival of activity from high altitudes during 1961 and 1962. Author

N65-27574# India. Dept. of Atomic Energy, Bombay. Analytical Div.
NEUTRON ACTIVATION ANALYSIS OF TRACES OF URANIUM: SOLVENT EXTRACTION AND γ-RAY SPECTROMETRIC DETERMINATION OF Np^{239}
A. Alian, R. Parthasarathy, and M. Sankar Das 1965 21 p refs
(AEET-211)

A neutron activation method has been described for the determination of uranium in aluminium and lead. The (n,γ) reaction of U^{238} has been used indirectly by isolating and counting Np^{239} formed by beta-decay of U^{239}. Samples and standards are irradiated in the Canada India Reactor at a flux of 10^{13} n.cm.$^{-2}$.sec.$^{-1}$ for about 3 days. The irradiated samples, after cooling for two days, are processed for the isolation of Np^{239}. The chemical procedure consists in dissolving the sample and separating the Np^{239} selectively by extraction with 2-thenoyl trifluoroacetone. The extracted neptunium is stripped with 10 M nitric acid and an aliquot is counted for its gamma activity. The overall recovery of neptunium was checked using Np^{39} tracer and found to be quantitative under the experimental conditions. Author

N65-27585# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OBTAINING INTENSIVE MOLECULAR BEAMS
Yu. N. Belyayev and V. B. Leonas 30 Mar. 1965 16 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 5, 1963 p 34–42
(FTD-TT-65-71/1+2; AD-614393)

A gasdynamic source of a molecular beam is described. The intensity of the beam realized by such a source exceeds the intensity of a classical furnace source by a factor of 70. Using mixtures as the working gas permits even a greater increase in intensity as well as the velocity of molecules in the beam. Author

N65-27595# Aerospace Research Labs., Wright-Patterson AFB, Ohio. General Physics Research Lab.
TABLE OF HARTREE–FOCK SELF CONSISTENT FIELD WAVE FUNCTIONS WITH EXCHANGE
T. K. Krueger, W. L. Mc David, and S. J. Czyzak Jan. 1965 497 p 2 refs
(ARL-65-10; AD-614428)

A table is presented of the Hartree-Fock wave functions for various atoms and ions mainly of astrophysical interest having atomic numbers up to 56. Also included in the table are the one-electron energy parameters and the relativistic and spin-orbit energy corrections. Author

N65-27598# National Bureau of Standards, Washington, D. C.
SELECTED TABLES OF ATOMIC SPECTRA. A: ATOMIC ENERGY LEVELS. B: MULTIPLET TABLES. Si II, Si III, Si IV, DATA DERIVED FROM THE ANALYSES OF OPTICAL SPECTRA
Charlotte E. Moore 25 Jun. 1965 31 p refs 2d ed.
(NSRDS-NBS-3, Sect. 1) GPO: $0.35

Data derived from the analyses of optical spectra are presented for silicon. The first section, *Atomic Energy Levels*, takes into account the revision of the conversion factor from cm^{-1} to eV, and all limits and energy levels (in cm^{-1}) have been multiplied by the factor 0.000123981 to obtain ionization and excitation potentials in eV. *Multiplet Tables*, which are presented in the second section, also make use of the revised conversion table. M.W.R.

N65-27602# Research Inst. of National Defence, Stockholm (Sweden).
OPTICAL MODEL PREDICTIONS OF NEUTRON CROSS-SECTIONS FOR N^{14}
B. Johansson Jun. 1965 10 p refs
(A-4433-411)

The total neutron cross-section and the differential cross-section for neutron elastic scattering from N^{14} have been calculated as functions of energy by making interpolations in optical model parameters. Author

N65-27613# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
A MACHINE PROGRAM FOR CALCULATING SLOW NEUTRON SCATTERING CROSS SECTIONS WITH EXACT AVERAGING OVER MOLECULAR ORIENTATION
L. J. Gannon and H. L. Mc Murry May 1965 18 p refs
(Contract AT(10-1)-205)
(IDO-17087) CFSTI: $1.00

This report describes a program for the IBM 7040 which calculates the scattering of slow neutrons by semi-rigid molecules in such a way that the correct average is obtained for scattering from all molecular orientations. The program is a modification of an earlier one which treats rotations classically, but treats vibrational energy transfers quantum mechanically. The input data are explained and illustrative applications to CH_4 and C_2H_6 are presented. Author

N65-27616# Oak Ridge National Lab., Tenn. Neutron Physics Div.
SOME CALCULATIONS OF THE FAST-NEUTRON DISTRIBUTION IN ORDINARY CONCRETE FROM POINT AND PLANE ISOTROPIC FISSION SOURCES
D. K. Trubey and M. B. Emmett Jun. 1965 64 p refs
(Contract W-7405-ENG-26)
(ORNL-RSIC-4)

Fast neutron dose rates and energy distributions due to point and plane isotropic fission sources in an infinite medium of ordinary concrete have been calculated by the moments-method code RENUPAK. As a check on the method, one Monte Carlo calculation was performed which yielded results that are in good agreement with those for the corresponding RENUPAK case. The effects of varying the concrete composition, especially the hydrogen content, and the lower energy cutoff were examined for several cases and found to be significant. Detailed tables of the energy spectra are given at lethargy steps of 0.1 from 0.001 to 18 MeV. Author

N65-27617# Oak Ridge National Lab., Tenn. Neutron Physics Div.
SURVEY OF METHODS FOR CALCULATING GAMMA-RAY HEATING
H. C. Claiborne Jun. 1965 118 p refs
(Contract W-7405-ENG-26)
(ORNL-RSIC-8)

The engineering design of nuclear reactors is largely governed by the heat liberated in the fission process and the subsequent absorption of the associated radiation. External to the fuel region, the main contribution to the heat generation rate usually results from energy degradation and absorption of gamma photons escaping from the fuel region. For some design conditions, gamma radiation arising from neutron capture can contribute significantly to the heat generation rate. This survey is concerned only with heat generation due to gamma rays, regardless of the source, interacting with the usual reactor materials. The purpose is to examine the various methods used in calculating gamma-ray heating for reactor design purposes. The methods discussed that are adaptable to hand calculations include the buildup factor method and the straightahead-scattering method. Author

N65-27660# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
GAMTEC II: A CODE FOR GENERATING CONSISTENT MULTIGROUP CONSTANTS UTILIZED IN DIFFUSION AND TRANSPORT THEORY CALCULATIONS
L. L. Carter, C. R. Richey, and C. E. Hughey Mar. 1965 79 p refs
(Contract AT(45-1)-1830)
(BNWL-35) CFSTI: $3.00

The GAMTEC II code generates multigroup constants in the energy range from 0 to 10 MeV for either homogeneous mixtures or heterogeneous arrays of cylindrical fuel elements. The thermal group constants are average over either (1) Wigner-Wilkins light moderator spectrum, (2) Wilkins heavy moderator spectrum, or (3) Maxwellian distribution. For heterogeneous arrays, the spacial thermal flux is calculated by the P_3 approximation. For epithermal energies, the slowing down distribution is described by either a P_1 or B_1 approximation to the Boltzman equation. Resonance absorption is calculated by the Adler-Nordheim method. Fast fission corrections are calculated by an n-flight collision probability technique. Multigroup constants are punched on cards in both HFN (diffusion theory) and DTF (S_n transport theory) formats. Author

N65-27671# Dow Chemical Co., Denver, Colo. Rocky Flats Div.
OBSERVATIONS OF GAMMA EMISSIONS ASSOCIATED WITH THORIUM REMOVAL FROM A U^{233} SAMPLE
R. A. Kirchner and K. J. Freiberg 16 Jun. 1965 21 p refs (Contract AT(29-1)-1106) (RFP-538)

Optimum times for handling the materials, after the thorium strike and subsequent chemistry, were studied. Pulse height analyses showed that there was no noticeable change in activity for the U^{233} oxide, but the constant activity level was expected since the material was approximately 2 1/2 years old. An initial rapid increase in the activity of the thorium precipitate sample was shown. It appears that few of the thorium daughters are removed and are expected to contribute to the initial activity levels of the UF_4. The effect of the thorium strike on the green salt sample showed an initial increase due to the decay of Ra^{224} and its daughters which were carried along with the green salt. Since the sand and slag traps some of the radium driven off during button firing, it appears to be advantageous to wait 2 or 3 weeks before any extensive work is done on this material. The gamma energy spectra for the various samples are graphically depicted, and the use of theoretical considerations to determine age and efficiency effects is detailed. R.W.H.

N65-27872# Library of Congress, Washington, D. C. Aerospace Technology Div.
CHARGE-EXCHANGE COLLISIONS IN GASES Surveys of Soviet-Bloc Scientific and Technical Literature
25 May 1965 66 p Compilation of abstracts (ATD-P-65-32; AD-465256)

One hundred twenty-two abstracts of Soviet research on charge-exchange processes in gases are presented. E.E.B

N65-27923# California Univ., Livermore. Lawrence Radiation Lab.
PROJECT SULKY. TOTAL CLOUD ACTIVITY MEASUREMENTS Final Report
Jerry L. Gaines 2 Jul. 1965 36 p refs (Contract W-7405-ENG-48 Proj. Sulky) (PNE-701F) CFST: $2.00

Gamma radiation detectors in three fixed ground stations and in a helicopter were used in an attempt to measure the total radioactivity as a function of time for the dust cloud produced by the Sulky event. Large plastic scintillators, photomultiplier tubes, and crudely collimated lead shields were the basic components of the detectors. A constant-current, variable-voltage regulator circuit enabled the detectors to operate in very high as well as in low radiation fields. Because the Sulky event did not crater as expected, there was no large radioactive dust cloud for the detectors to observe. Instead a small dust cloud of relatively low activity was produced, followed immediately by a continuous stream of much more radioactive gas which flowed from the resulting pile of rubble for a considerable length of time. Author

N65-27939# Atomic Energy Commission, Washington, D. C. Div. of Plans and Reports.
FUNDEMENTAL NUCLEAR ENERGY RESEARCH, 1964
Dec. 1964 311 p refs GPO: $2.00

Some of the more significant advancements made under AEC sponsored fundamental research and development are summarized. The summary is limited to certain aspects of the more fundamental studies in physical research, isotopes, reactor technology, biology, and medicine. The majority of the studies are of a basic research nature in which the effort was directed to acquiring or confirming scientific information. Among the specific items found in the report was the discovery of the omega minus hyperon in that it may be the keystone to an orderly arrangement of the previously known particles. In the field of low-energy physics, quantum mechanical wave functions model, nucleon–nucleus potential, three particle excitation in deformed nuclei, magnetic moments of nuclear states, and a new atomic-beam magnetic-resonance apparatus are discussed as especially noteworthy articles. Mathematics and computer research, chemistry, metallurgy, and controlled thermonuclear research are included. The fabrication by neutron transmutation doping, Rutherford scattering chemical analysis of solids, and the Cu^{232} program are discussed under isotopes. E.E.B.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-26796 Naval Research Lab., Washington, D. C. Radiation Div.
CLAMP SYSTEM FOR THE PHAROS 2MJ ENERGY STORAGE CAPACITOR BANK
A. C. Kolb, W. H. Lupton, and M. P. Young *In its* Rept. of NRL Progr. Apr. 1965 p 11–16 refs (See N65-26794 16-34)

To determine the factors which limit the confinement time of the high-temperature plasma produced by magnetic compression, the Pharos 2-megajoule theta-pinch was modified in order to extend the duration of the coil current. This was accomplished by shortcircuiting (clamping) the coil at peak current (15 million amperes) with several hundred three-electrode vacuum switches. The switches which were developed, the installation on the Pharos system, and operational data are discussed. Author

N65-26931# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
MEASUREMENT OF CESIUM EXCITATION CROSS SECTION NEAR THRESHOLD BY A SWARM TECHNIQUE
J. F. Nolan and A. V. Phelps 15 Apr. 1965 38 p refs (Contract Nonr-2584(00); ARPA Order 125-63, Proj. Defender) (TR-28; AD-615163)

Electron drift velocities have been measured in cesium-argon mixtures for E/N values between 3×10^{-19} and 5×10^{-18} V-cm^2 and cesium to argon concentration ratios between 10^{-18} and 10^{-5}. The drift velocity was obtained from

measurements of the electron transit time using an ac technique which is a modification of a technique developed originally by Rutherford for ion drift velocity measurements. Numerical solutions of the Boltzmann transport equation were used to determine an excitation cross section which is consistent with the experimental drift velocity data. For a single excitation threshold at 1.386 eV, the best slope for a linear cross section is 7.1×10^{-15} cm^2/eV. If excitation to the 6 $P_{1/2}$ and 6 $P_{3/2}$ states is considered separately, with thresholds at 1.386 eV and 1.454 eV respectively, the linear cross sections obtained have a slope of 2.5×10^{-15} cm^2/eV for 6 $P_{1/2}$ excitation, and 5.0×10^{-15} cm^2/eV for 6 $P_{3/2}$ excitation. The range of validity of these values is from threshold up to about 1.8 eV. Other shapes for the cross section are investigated. The experimental cross section is in reasonable agreement with extrapolations of theoretical cross sections. Author

N65-27035# Joint Publications Research Service, Washington, D. C.
TOTAL OSCILLATIONS IN PLASMA
A. I. Akhiyezer et al 29 Jun. 1965 159 p refs Transl. into ENGLISH of the book "Kollektivnyye Kolebaniya v Plazme" Moscow, 1964 p 1–164
(JPRS-30853; TT-65-31374) CFSTI: $5.00

Natural oscillation spectra of free plasma, stability and instability of various particle distributions, and fluctuations in homogeneous plasma are examined. Natural oscillation spectra are studied both for equilibrium and dual-temperature plasma in the absence and presence of an external magnetic field. Frequencies and decrements of damping caused by resonance interaction of particles with a field, are determined for Langmuir oscillations, non-isothermal sound, modified Langmuir oscillations in a magnetic field, electron- and ion-cyclotron waves, and magnetohydrodynamic waves. Excitement of the waves with external currents was also examined. In the case of equilibriumless plasmas, total oscillations are not only able to be damped but can grow. This phenomenon is manifested in the passage of charged particle beams through plasma. Stability and instability criteria were established for various particle distributions in both free plasma and for plasma in an external magnetic field. LS.

N65-27044# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut für Energiewandlung und Elektrische Antriebe
REVIEW ON POSSIBLE APPLICATIONS OF ELECTRODELESS MHD-SYSTEMS [UBERBLICK UBER DEN STAND DER UNTERSUCHUNGEN UND MOGLICHKEITEN DER ANWENDUNG QUASISTATIONARER ELEKTRODENLOSER MHD-SYSTEME]
W. Peschka Aug. 1964 34 p refs In GERMAN; ENGLISH summary
(DVL-315; DLR-FB-64-14) Available from Zentralstelle für Luftfahrtdokumentation und Inform. (ZLDI), Munich: 9, 20 DM

A short review is presented on the application of electrodeless MHD-systems for space power. Generator action results from the interaction between a magnetic travelling wave and circulating electric currents in a good conducting plasma. The magnetic travelling wave can be generated by polyphase coils or by transmission lines or in another way. Because of the required strong magnetic fields the application of superconducting materials is of great importance. Because the generator has no electrodes in contact with the hot working gas and because the magnetic travelling field is also a confining field for the plasma thereby eliminates the most difficult materials problem in the DC MHD Generator. Author

N65-27049# Stanford Research Inst., Menlo Park, Calif.
DIAGNOSTICS AND MICROWAVE SCATTERING FOR AN UNDERDENSE TURBULENT PLASMA
H. Guthart, D. E. Weissman, and T. Morita May 1965 44 p refs
(Contract ARPA SD-103; ARPA Order 281-62)
(TR-27; AD-464601)

A turbulent plasma in thermal equilibrium has been formed by seeding a premixed flame in a combustion chamber and then exhausting through an expansion nozzle into a low-pressure vessel. The rms and mean electron density has been measured throughout the turbulent plasma. In addition to measurements of the average electron density properties, the one dimensional power spectral density function of the electronic fluctuations as well as the mean electron velocity has been measured. The measured power spectral density function, F(f), can be approximated by the relation $F(f) = F(0)\ (1 + C^2f^2)^{-1}$, where f is the frequency. Measurements of the bistatic radar cross section from the underdense turbulent plasma have been made. The measured relative cross section as a function of bistatic angle is in good agreement with that predicted by the Booker–Gordon theory. A comparison of the scattering measurements with the results of a diagnostic program for the determination of the electron properties in the scattering volume indicates good qualitative agreement. The power spectral density function of the scattered microwave signal has been measured and is seen to have a $(frequency)^{-4}$ fall off at high frequencies. Author

N65-27098# Cornell Univ., Ithaca, N. Y. Electrical Engineering Research Lab.
INVESTIGATION OF LINEAR BEAM AND NEW CONCEPTS OF MICROWAVE POWER. VOLUME V: INTERACTION OF HIGH-POWER ELECTRON BEAM AND PLASMA
D. M. Kerr, Jr., S. Y. Narayan, and R. J. Myers Griffiss AFB, N. Y., RADC, Apr. 1965 266 p refs
(Contract AF 30(602)-3243)
(RADC-TR-64-563, Vol. V; AD-615940)

A Penning discharge was used to generate in hydrogen a plasma suitable for use in a microwave electron beam-plasma amplifier. Plasma densities on the order of 10^{11} electrons per cubic centimeter were obtained. A two-fluid theoretical model of the plasma was developed in order to explain the operation of the discharge. It is supported by diagnostic measurements of two kinds, microwave-cavity measurements and probe measurements. The detuning of a resonant microwave cavity was found to be a fast and reliable method for measuring the averaging plasma density. Probe measurements provided information on the average plasma-electron energies and on the shape of the radial plasma-density profile. The design of the cavities is described in full, and equivalent circuit concepts are found to be useful in interpreting the experimental results. The probe and cavity measurements both showed that plasma densities that will permit the operation of a beam-plasma amplifier at S-band can be generated in the present system using hydrogen gas. If higher-frequency operation is desired, the theoretical model indicates that higher discharge currents and a heavier gas will be necessary. Author

N65-27101# Illinois Univ., Urbana. Coordinated Science Lab.
OSCILLATIONS IN A ONE-DIMENSIONAL, INHOMOGENEOUS PLASMA
E. A. Jackson and M. Raether Jan. 1965 25 p refs
(Contract DA-28-043-AMC-00073(E))
(R-239; AD-610756)

Detailed calculations of the eigenfrequencies and their damping rates for a one-dimensional inhomogeneous plasma

in the long wavelength regime are presented. Starting with the one-dimensional Vlassov and Poisson equation, the eigenfrequencies, and eigenvectors are considered. The Landau-damping mechanism for oscillations in inhomogeneous plasma is discussed. N.E.A.

N65-27120# Max-Planck-Institut für Physik und Astrophysik, Munich (West Germany).
PARTICLE LOSSES OF A CESIUM PLASMA IN A STELLARATOR (2)
D. Eckhartt and G. Grieger Oct. 1964 20 p refs
(MPI-PA-29/24)

A scaling law is derived which enables experimental results with an alkali plasma to be applied to a hydrogen plasma. Experiments in the stellarator are discussed for a cesium plasma which was generated by contact ionization on a small piece of Ta-metal heated to a temperature of about 2300° K. The particle density was determined by Langmuir probes by measuring the ion saturation current. It was observed that the mean particle life time, as well as the shapes of the particle density profiles, showed no remarkable difference whether or not the particle density was in the range where the scaling law was satisfied. Also, the probe measurements gave no indication of a plasma motion in the direction of major axis. Therefore, it was concluded that no secondary-currents flow through the plasma. E.E.B.

N65-27198# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.
FLOW OF PLASMA AROUND A MAGNETIC DIPOLE Scientific Report No. 1
W. H. Bostick, H. Byfield, P. Casale, and J. Di Marco Mar. 1965 16 p refs
(Contract AF 19(628)-2398; Grant AF-AFOSR-465-65)
(SIT-P144 (3/65); AFCRL-65-293; AD-615780)

Image converter photographs of plasma flow over a magnetic dipole field exhibit general boundary shapes which are in accord with the theoretical shapes computed on the basis of specular reflection of the ions at the boundary of the magnetic cavity. Magnetic probe measurements show that the magnetic field is highly turbulent in the magnetic boundary and correlation measurements show that this turbulence is not a breathing of the boundary as a whole, but a corniness in the direction perpendicular to the magnetic field and the initial plasma flow. Electric-field probe and ion density probe measurements also show that plasma is turbulent in the boundary of the magnetic cavity, and that the plasma penetrates the cavity in a turbulent state. The character of the signals suggests that the turbulence is in the form of plasma eddies or vortices. Author

N65-27228 Joint Publications Research Service, Washington, D. C.
THE PROPAGATION OF WAVES OF FINITE AMPLITUDE IN A PLASMA WITH A CONSIDERATION OF THE EFFECT OF CHARGE SEPARATION
A. D. Pataraya *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 27–35 refs (See N65-27225 16-34) CFSTI: $6.00

The structure of finite amplitude waves propagating along a magnetic field in a collisionless plasma was studied using the perturbation theory. Emphasized is the effect of charge separation on the characteristic quantities of the plasma. Included are derivations for hot and cold plasma. S.C.W.

N65-27229 Joint Publications Research Service, Washington, D. C.
TWO-DIMENSIONAL ELECTROMAGNETIC FIELDS GUIDED BY PLASMA LAYERS. II
I. G. Kondrat'yev and M. A. Miller *In its* Izv. VUZov: Radiophysics, Vol. VIII, No. 1, 1965 24 Jun. 1965 p 36–46 refs (See N65-27225 16-34) CFSTI: $6.00

Continued research designed to determine the possible existence of localized electromagnetic waves guided by layers of a homogeneous isotropic plasma is reported. Considered are certain variations of two-dimensional waveguide systems with gyrotropic plasma walls. To establish whether a group of such layers may form waveguide systems with localized or quasi-localized fields, the reflection factor and the surface impedance factor for plasma layers with a constant magnetic field oriented either along or across the direction of wave propagation, were determined. Also included are data on the conditions under which such layers may shield high-frequency electromagnetic fields. S.C.W.

N65-27230 Joint Publications Research Service, Washington, D. C.
ENERGY LOSSES DURING THE MOTION OF A CHARGE IN A HETEROGENEOUS MAGNETOACTIVE PLASMA
V. V. Tamoykin *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 47–57 refs (See N65-27225 16-34) CFSTI: $6.00

Energy losses due to radiation of extraordinary and ordinary electromagnetic waves in uniform motion of a charge along a magnetic field superimposed on a plasma with random, weak, electron density fluctuations were calculated. Fluctuations of the magnetic field and the thermal motion of electrons in the plasma were not considered. Calculations were performed by the radiation reaction method, with the use of the tensor of the effective dielectric permeability of a heterogeneous plasma. It is shown that the radiation of both types of normal waves in a heterogeneous magnetoactive plasma originates in the frequency range $\omega > \omega_p$, where Cherenkov excitation of the electromagnetic waves is impossible. Also, an effect of logarithmic increase in the intensity of the fluctuation radiation was noted as the radiation of the extraordinary waves approached the Cherenkov threshold. S.C.W.

N65-27231 Joint Publications Research Service, Washington, D. C.
ON THE THEORY OF INSTABILITY OF AN ANISOTROPIC PLASMA WITH A BEAM
S. Ye. Rosinskiy, A. A. Rukhadze, and V. G. Rukhlin *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 58–66 refs (See N65-27225 16-34) CFSTI: $6.00

A study designed to determine the minimum beam velocity at which plasma instability originates is reported. Presented is a theoretical analysis of low-frequency oscillations of an anisotropic plasma with a beam, both in the absence and presence of an external magnetic field. Results show that in the absence of the magnetic field, a spatially unlimited anisotropic plasma is unstable at as many small directional velocities of the beam as is desired. The values of the ciritcal beam velocities at which low-frequency instability originates in a limited plasma were estimated. It was further demonstrated that a strong magnetic field stabilizes the plasma instability by shifting the region of instability toward the greater directional velocities of the beam. S.C.W.

N65-27232 Joint Publications Research Service, Washington, D. C.
ON THE PROPAGATION OF ELECTROMAGNETIC WAVES IN A MEDIUM WITH A VARIABLE REFRACTION INDEX

L. P. Presnyakov and I. I. Sobel'man *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 67–76 refs (See N65-27225 16-34) CFSTI: $6.00

Presented is an analysis of the applicability of a new method for integrating a system of linear differential equations with variable coefficients to the problem of electromagnetic wave propagation in a medium with a variable real refraction index. Emphasized is the effectiveness of the method in calculating the reflection factor from a layer with an arbitrary real value. S.C.W.

N65-27233 Joint Publications Research Service, Washington, D. C.

ON THE RADIATION REACTION IN A CASE OF LONGITUDINAL WAVES

G. V. Gorodinskiy *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 77–84 refs (See N65-27225 16-34) CFSTI: $6.00

On the basis of calculations of the radiation reaction (friction) in a medium (isotropic plasma) with negative absorption in the presence of spatial dispersion, it was demonstrated that the radiation intensity of longitudinal waves is a much greater factor of $(C/V_T)^3$ (where C is the speed of light and V_T is the thermal velocity of the electrons in the plasma) in a certain range of variation of V_T than in the medium without spatial dispersion. S.C.W.

N65-27243 Joint Publications Research Service, Washington, D. C.

THE INFLUENCE OF CONSTANT ELECTRIC AND MAGNETIC FIELDS ON THE FORMATION TIME OF ULTRA-HIGH-FREQUENCY PULSE DISCHARGES IN GAS

S. M. Levitskiy, A. Ya. Yavlinskiy, and I. V. Shirokov *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 210–218 (See N62-27225 16-34) CFSTI: $6.00

An investigation has been made of the influence of constant electric and magnetic fields upon the time of formation of ultrahigh-frequency pulse discharges in air at pressures of 10^{-3} to 10^{-1} mm Hg. It is shown that a constant electrical field increases but a constant magnetic field decreases the time of discharge formation (in the vicinity of cyclotron resonance). During their joint action the electric field compensates for the influence of the constant magnetic field on the discharge formation time. Author

N65-27297*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

THE EFFECT OF HIGH PRESSURES ON THE CONDUCTIVITY OF VAPORS Summary Report, 22 Jan. 1964–21 Jan. 1965

S. W. Kurnick and J. F. Colwell 28 May 1965 122 p refs (Contract NAS3-4119)
(NASA-CR-54353; GA-6117) CFSTI: HC $4.00/MF $1.00 CSCL 20I

Studies were conducted to determine whether increasing the density of metallic vapors would cause them to exhibit electrical conductivity. Theories based on a one-electron model indicate that metals having low ionization potentials (i.e., the alkali metals) should have the highest conductivity. Calculations indicated that the conductivity of Hg:Cs alloys should be high enough to be of interest. Theories based on a many-body model also indicated that Hg:Cs alloys should be a good candidate. Experiments in a high pressure autoclave were conducted on pure Hg vapor at pressures up to 735 atm. No conductivity attributable to the vapor was observed, indicating a conductivity $\sigma \leq 10^{-2}\Omega/m$. Measurements on 95% Hg:5% Cs were made at temperatures up to 1460° C and at pressures up to 965 atm. A decrease in electrical losses was observed and may have been caused by conductivity within the vapor, however, the evidence is not conclusive. However, it does not appear that useful conductivities can be attained in the Hg:Cs system at reasonable pressures (up to 300 atm). Author

N65-27393*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

TWO-STEP PROCESS TO INCREASE ATOMIC HYDROGEN ION PRODUCTION IN LOW-PRESSURE RADIOFREQUENCY DISCHARGE

George M. Prok Washington, NASA, Jul. 1965 15 p refs (NASA-TN-D-2912) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Atomic ion production in a low-pressure hydrogen plasma was improved by employing a two-step process. In the first step, hydrogen molecules are dissociated at high pressures (approximately 450μ) with microwaves at a frequency of 2450 megacycles. The second step consists of expanding the partially dissociated hydrogen through an orifice to the low-pressure region (3 to 6μ), where it is ionized by a radiofrequency coil, which is operated at a frequency of 14 megacycles. Atomic hydrogen decay in the low-pressure region was minimized by eliminating all catalytic surfaces. The maximum increase in proton production was found to be 300 percent above that of a hydrogen plasma with no predissociation. This maximum improvement occurred when the low-pressure region was at 3.2 microns. The intensities of the H_ε, H_δ, H_γ, and H_α Balmer lines, which were determined experimentally to have essentially no molecular contribution, were used to determine the increase in atomic hydrogen ion-production rate over that of no prior dissociation. Author

N65-27411# Commissariat à l'Energie Atomique, Saclay (France). Groupe de Recherches sur la Fusion Controlè

EXPERIMENTAL DETERMINATION OF THE DENSITY ON THE INDUCTION GUN USING THE STARK WIDENING OF THE Dβ LINE [DETERMINATION EXPERIMENTALE DE LA DENSITE SUR LE CANON A INDUCTION PAR L'ELARGISSEMENT STARK DE LA RAIE Dβ]

Jean Jacquinot and Francois Waelbroeck Brussels, EURATOM, Nov. 1964 38 p refs In FRENCH; ENGLISH summary (Contract EURATOM-007-62-1 FUAF)
(CEA-R-2701; EUR-2154.f) Available from Belg. Am. Bank and Trust Co., New York Account No. 22.186: 50 Belg. Fr.

A rapid survey is made of the characteristics of the aparatus and of the assembly used. The alignment and calibration techniques are examined, and the measurement results are given with a discussion of the possible causes of error in the interpretation of the profiles obtained. A more particular study is made of the modification in the profile of the Dβ line emitted by a non-homogeneous plasma: these can be quite pronounced, even in the case of a gaussian radial distribution of the plasma density. Author

N65-27505# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.

REVIEW OF MAGNETOFLUIDDYNAMIC APPLICATIONS

T. E. Turner, ed. Apr. 1965 149 p refs *Its* Flight Sci. Lab. Rept. No. 96
(D1-82-0435)

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7. ARC HEATERS AND MHD ACCELERATORS FOR AERODYNAMIC PURPOSES. REPORT ON AGARD SPECIALISTS MEETING OF SEPTEMBER 1964 IN BELGIUM W. G. Harris p 141–147

N65-27506 Boeing Scientific Research Labs., Seattle, Wash.
GENERATORS
Gordon C. Oates (MIT) *In its* Rev. of Magnetofluiddyn. Appl. Apr. 1965 p 1–32 refs (See N65-27505 16-25)

Magnetofluiddynamic generators utilizing several classes of working fluids are under investigation today, principal among these being: (1) seeded, noble gas generators; (2) alkali metal vapor generators; and (3) combustion generators. A development of some of the elementary theory necessary for an understanding of the behavior of generators, and a brief discussion of the requirements and state of developments of generators utilizing each of the classes of working fluids listed are given. N.E.A.

N65-27508 Boeing Scientific Research Labs., Seattle, Wash.
WIND TUNNELS
R. Goldstein *In its* Rev. of Magnetofluiddyn. Appl. Apr. 1965 p 79–100 refs (See N65-27505 16-25)

The possibility of using an magnetofluiddynamic device for wind tunnel driving has attracted the interest of a number of investigators in recent years. To date, the work on such devices has not been extensive, but has given some promising results. A summary of the work being done on magnetofluiddynamic wind tunnel drives is presented. A discussion on what the capabilities and limitations of these devices appear to be at present is given. N.E.A.

N65-27509 Boeing Scientific Research Labs., Seattle, Wash.
FLIGHT CONTROLS
G. V. Mullaney and E. A. Brown *In its* Rev. of Magnetofluiddyn. Appl. Apr. 1965 p 101–115 refs (See N65-27505 16-25)

Magnetofluiddynamics has to do with the motion of conducting fluids in magnetic fields. Such motions give rise to currents in the fluid, which in turn interact with the magnetic field to yield a body force acting on the fluid. Magnetofluiddynamic flight control can include both steering and braking wherein the ballistics parameter $W/C_d A$ is altered. This article is concerned with the application of this body force for steering a high speed vehicle. In order to assess the feasibility of magnetofluiddynamic control, two parameters have been evolved: (1) the interaction parameter, which is a measure of the magnetic forces with the aerodynamic forces; and (2) the magnetic Reynold's number which is a measure of the distortion of the applied magnetic field. Two examples of flight control designs are given. N.E.A.

N65-27510 Boeing Scientific Research Labs., Seattle, Wash.
BOUNDARY LAYERS
F. D. Hains *In its* Rev. of Magnetofluiddyn. Appl. Apr. 1965 p 117–130 refs (See N65-27505 16-25)

A discussion is given on the use of magnetofluiddynamic boundary layers in liquid metal bearings. A review of the various types of magnetofluiddynamic bearings is presented. The possible use of magnetic fields to reduce the convective heat transfer at the nose of reentry bodies is discussed and a review of the reentry problem is given. N.E.A.

N65-27511 Boeing Scientific Research Labs., Seattle, Wash.
SHOCK TUBES
H. G. Ahlstrom (Washington Univ., Seattle) *In its* Rev. of Magnetofluiddyn. Appl. Apr. 1965 p 131–141 refs (See N65-27505 16-25)

A review of the reasons for building shock tubes and an examination of the limitations of conventional shock tubes which have led to the development of electromagnetic shock tubes are given. Several configurations of electromagnetic shock tubes are discussed and their shortcomings as well as their advantages are pointed out. N.E.A.

N65-27610 Joint Publications Research Service, Washington, D. C.
THE PLASMA JET FLAME—A VERSATILE AID IN METAL PROCESSING
Chen-teh Hsia *In its* Transl. on Communist China's Sci. and Technol. 11 Jun. 1965 p 9–14 Transl. into ENGLISH from K'o-hsueh Ta-chung (Peiping), No. 4, Apr. 1965 p 8–9 (See N65-27608 16-34) CFSTI: $1.00

Plasma jet flame applications to the processing of metal and nonmetal materials in procedures such as cutting, welding, spray plating, and heat treatment are discussed. Plasma spray plating forms an even layer of heat, friction, and corrosion tolerant plating and is well suited for hard to melt materials. The inert gases used as the working medium will not interact with the plating materials. The linear materials and the powder form of spray plating and their particular applications are discussed. In plasma jet welding the plasma arc heating is concentrated with a high degree of heat efficiency, the melting depth and breadth, and the amount of welding to be done are easily controlled and regulated, and all kinds of steel materials and colored metals can be welded giving compact seams and a smooth appearance. Plasma jet cutting can easily handle stainless steel, cast iron, colored metal, and hard to melt metals. It can also cut asbestos cement, diamonds, ceramics, and fire resistant brick. The cutting edge is even and smooth, the field affected by the boundary heat is small, and

D.M.A.

N65-27642*# National Aeronautics and Space Administration, Washington, D. C.
FLOW IN A CONDUIT OF AN ELECTRICALLY CONDUCTING COMPRESSIBLE FLUID UNDER THE ACTION OF A NONUNIFORM MAGNETIC FIELD [ECOULEMENT EN CONDUITE D'UN FLUIDE COMPRESSIBLE, CONDUCTEUR DE L'ELECTRICITE SOUS L'ACTION D'UN CHAMP MAGNETIQUE NON UNIFORME]
Roger Peyret Jun. 1965 13 p refs Transl. into ENGLISH from FRENCH
(NASA-TT-F-9397) CFSTI: HC $1.00/MF $0.50 CSCL 20I

The two-dimensional flow in mean-square time, in a plasma accelerator with progressive waves is discussed, specifically taking into consideration the effect of the axial component of the magnetic field. The solution obtained by the linearization method permits calculating the acceleration of the fluid and demonstrates a confinement effect. Author

N65-27683*# National Aeronautics and Space Administration, Washington, D. C.
ANOMALOUS PLASMA DIFFUSION IN ION CYCLOTRON RESONANCE [ANOMAL'NAYA DIFFUZIYA PLAZMY v IONNOM TSIKLOTRONNOM REZONANSE]
V. V. Chechkin, M. P. Vasil'yev, L. I. Grigor'yeva, and B. I. Smerdov (Acad. of Sci., Ukrain. SSR) May 1965 24 p refs Transl. into ENGLISH from Yadern. Sintez (Vienna), v. 4, 1964 p 145–151
(NASA-TT-F-9377) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Increased diffusion of a plasma located in a constant magnetic field and heated by a high-frequency field, whose frequency is close to ion cyclotron frequency, was experimentally investigated. It is shown that anomalous diffusion across the lines of force of a constant magnetic field occurs in the low-temperature after-glow plasma, if the amplitude of the high frequency field exceeds a certain critical value. The heightened diffusion, which causes accelerated plasma decay, is associated with the conversion of the plasma into a turbulent state with a broad spectrum of random oscillations. The data obtained lead to the assumption that this phenomenon occurs when ion drift in a direction perpendicular to the constant magnetic field reaches a definite value, which can be characterized by the ratio of the high-frequency field amplitude to the neutral gas pressure. Apparatus is described, and graphs are included showing interdependency of magnetic field and decay time. L.S.

N65-27716*# National Aeronautics and Space Administration, Washington, D. C.

CERTAIN NEW RESULTS ON PLASMA CONFINEMENT IN A MAGNETIC TRAP [NEKOTORYYE NOVYYE RESUL'TATY PO UDERZHANIYU PLAZMY U MAGNITNOY LOVUSHKE]

Yu. V. Gott, M. S. Ioffe, and V. G. Tel'kovskiy Jun. 1965 9 p refs Transl. into ENGLISH from Yadern. Sintez (Vienna), 1962 Suppl., Pt 3, Plasma Phys. and Controlled Nucl. Fusion Res. Conf. Proc., Salzburg, 4–9 Sep. 1961; IAEA, Vienna, 1963

(NASA-TT-F-9430) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Tentative results on preventing the escape of plasma from a magnetic trap, by modifying the field configuration through superposition of an auxiliary conductor field, are reported with comparative oscillograms for the flux of neutral particles with and without an additional field. An auxiliary field will eliminate the extensive pulsations of plasma density near the walls of the trap, by preventing groove-type plasma instabilities. The plasma lifetime is increased by enlarging the auxiliary field up to saturation, after which the lifetime depends only on the hydrogen pressure. Author

N65-27725*# National Aeronautics and Space Administration, Washington, D. C.

EXCITATION OF SOUND WAVES IN A WEAKLY IONIZED PLASMA [PRO ZBUDZHENNYA ZVUKOVIKH KHIL' V SLABKOYONYZOYANYY PLAZMY]

V. V. Angeleiko and A. B. Kitsenko Jun. 1965 9 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 10, no. 1, 1965 p 16–20

(NASA-TT-F-9449) CFSTI: HC $1.00/MF $0.50 CSCL 20I

The authors investigated the low-frequency electron-ion oscillations of a weakly ionized plasma. It is assumed that the equilibrium distribution of electrons satisfies by velocities the kinetic equation with the collision integral in Davydov's form. It is shown that the electron drift with respect to ions, in the presence of a strong external electric field, may lead to the instability of distribution obtained by Davydov. The instability is associated with the excitation of electron-ion oscillations. Author

N65-27774# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

COLLECTIVE PROCESSES AND SHOCK WAVES IN RARIFIED PLASMA

R. Z. Sagdeev Apr. 1965 77 p refs Transl. into ENGLISH of the publ. "Kollektivnye Protsessy i Ydarnye Volny v Razrezhennoi Plasme" Novosibirsk Akad. Nauk SSSR, 1963 (AEC-tr-6509) CFSTI: $3.00

Basic ideas and results of the theory of collective processes in a rarefied plasma are described, with emphasis on qualitative explanations. Nonlinear oscillations of a plasma and shock waves without collisions in a rarefied plasma are detailed. M.W.R.

N65-27813*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DETERMINATION OF PLASMA TEMPERATURE AND ELECTRON DENSITY DISTRIBUTIONS USING MILLIMETER WAVES

William F. Leonard Washington, NASA, Jul. 1964 12 p refs (NASA-TN-D-2892) CFSTI: HC $1.00/MF $0.50 CSCL 20I

A method for obtaining good spatial resolution in the measurement of electron density and temperature variations in a thermal plasma of cylindrical cross section using millimeter waves is described. The technique, which is an application of the Abel inversion technique, involves the division of a plasma into concentric zones and evaluation of the attenuation constant in each zone from measured attenuation losses. Results of measurements made on a cyanogen oxygen flame at 61.2 Gc are given, and correlation of the peak temperature (4470° K) at the center of the flame with spectroscopic measurements is shown. Author

N65-27836# Williamson Development Co., Inc., West Concord, Mass.

RESEARCH DIRECTED TOWARD PLASMA STABILITY STUDIES IN MAGNETIC FIELDS Final Report, Mar 1963–Mar. 1965

Arthur L. Besse, Balram Prasad, Pradip Bakshi, Kenneth I. Golden, and Ivan A. Nichols 15 Mar. 1965 88 p refs (Contract AF 19(628)-2843)

(AFCRL-65-315; AD-616099)

Section I describes preliminary X-ray studies of high density plasmas produced by exploding wires. Symptoms of turbulence, which are always observable in light–picture studies, were not detected in the X-ray photographs. Further investigations are suggested wherein dual X-ray equipment might be used together with more accurate scanning techniques. Section II describes an interferometer with laser source as a means of determining electron densities. Further described therein is an electron beam instrument for determining heavy particle densities. Section III discusses the physical characteristics and implications of the moving radiation sources observed in the shock tube experiments. In Section IV, the electrical conductivity of a partially ionized gas in a uniform magnetic field is determined. This extension of the Sen–Wyller magneto–ionic theory was motivated by the fact that ionospheric, interstellar, and laboratory plasmas do contain neutral gas molecules. In Section V, a nonlinear analysis of plasma oscillations reveals the existence of: (1) composite modes resulting from the repeated mutual interaction of the incident field and plasma components; (2) an infinity squared of Larmor resonances. Section VI is a conjectural study of small amplitude wave motions in a two-stream hydromagnetic gas with Hall perturbations. Author

N65-27879# Little (Arthur D.), Inc., Cambridge, Mass.

CHARACTERISTICS OF METAL VAPORS Interim Report, 15 May 1963–3 Sep. 1964

A. E. Wechsler, P. E. Glaser, and J. Jasperse Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Mar. 1965 61 p refs (Contract AF 33(657)-11735)

(ARL-65-53; AD-616110)

The objective of this experimental and analytical study is to determine the effects of metal vapors on the radiation heat transfer characteristics of arc and plasma systems. A

high temperature absorption cell suitable for transmission measurements of alkali metal vapors at temperatures of 300 to 750° C with vapor path lengths of 4 to 8 inches is described. The results of calibration tests using the absorption cell and an optical system capable of resolution of 1 to 8 Å over the spectral region from 2000 to 9000 Å are presented. Typical data on the transmission of sodium vapor are given, and methods of data reduction to obtain spectral absorption coefficients are proposed. A preliminary discussion of the radiation characteristics of vaporized electrode components such as tungsten, copper, and graphite is given. Author

N65-27900# Westinghouse Electric Corp., Pittsburgh, Pa Westinghouse Research Labs.
ARC DISCHARGE SOURCES Semiannual Technical Summary Report, 16 Oct. 1964–15 Apr. 1965
Charles H. Church and Richard G. Schlecht 15 May 1965 139 p refs
(Contract Nonr-4647(00); ARPA Order 306-62; Proj. Defender) (Rept.-65-9C1-148-R3; AD-462792)

A simple theoretical model for the high energy pulsed arc discharge has been proposed, in which thermal conduction and radiative transfer occur within the arc. Radiative transfer is discussed both in general and as applied to the model. The theoretical evaluation of the various physical properties of the arc plasma, that are required in finding a solution to the model, including absorptivity, thermal and electrical conductivities are described using simple and relatively complete expressions. Calculations which consider the arc to be of homogeneous temperature of the form of a plane parallel slab and a cylinder are described, with results indicated for the plane parallel slab using a simplified representation of the electron density and absorptivity. Experimental measurements necessary to validate the model are discussed. Measurements of the spectral radiance in the ultraviolet at different radial points are presented. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-26765# Naval Ordnance Lab., Corona, Calif.
FOUNDATIONAL RESEARCH PROJECTS Quarterly Report, Oct.–Dec. 1964
C. J. Humphreys 1 Mar. 1965 133 p refs
(NAVWEPS-8226; AD-613340)

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3. COUPLING REACTIONS BETWEEN HEXAPHENYLDIAZIDOCYCLOPHOSPHONITRILE AND SELECTED BISTERTIARY PHOSPHINES A. J. Bilbo and C. M. Sharts p 16–43 refs (See N65-26768 16-06)

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7. PLASMA AND SPIN RESONANCE IN SEMICONDUCTORS, MEASURED WITH THE VARIAN V-4500 EPR SPECTROMETER G. Zaeschmar p 85–94 refs (See N65-26772 16-26)

8. FLUORESCENCE SPECTRUM OF PR^{3+} IN LAF_3 H. E. Rast and R. A. Buchanan p 95–113 refs (See N65-26773 16-26)

9. INTERMEDIATE COUPLING ENERGY LEVELS FOR Nd^{3+} ($4f^3$) IN LaF^3 H. H. Caspers, H. E. Rast, and R. A. Buchanan p 114–133 refs (See N65-26774 16-26)

N65-26770 Naval Ordnance Lab., Corona, Calif. Infrared Div.
COVARIANT FORM OF THE GYRATION VECTOR OF AN INSULATING CRYSTAL FOR FREQUENCIES CLOSE TO THE GAP FREQUENCY
A. Nedoluha *In its* Foundational Res. Proj. 1 Mar. 1965 p 53–67 refs (See N65-26765 16-26)

The general perturbation theoretical approach to magneto-optical phenomena in the nonabsorbing region of systems in an isolated ground state was applied to insulating crystals at frequencies close to the gap frequency under consideration of electron spin. The dominant terms of the gyration vector, and hence of Faraday rotation, were expressed by band parameters characterizing the top of the valence band and the bottom of the conduction band. The discussion is limited to wave vectors small enough that the interaction of the valence bands with the conduction bands can be taken care of by the nondegenerate perturbation theory. The dominant parts of the density matrix and the Green function were cast in covariant form with respect to unitary transformations among the basic functions for the edges of the valences or the conduction bands, respectively. G.G.

N65-26771 Naval Ordnance Lab., Corona, Calif. Infrared Div.
IMPROVED TECHNIQUE FOR THE MEASUREMENT OF THE ROTATION OF THE PLANE OF POLARIZATION
C. J. Gabriel, V. A. Patton, and H. Piller *In its* Foundational Res. Proj. 1 Mar. 1965 p 69–85 refs (See N65-26765 16-26)

A double beam method for measuring the rotation of the plane of polarization due to the Faraday effect is described, in which the light beam is split into two beams polarized perpendicular to each other after it passes through the sample. Each of the light beams illuminates separate photodetectors that are connected with a bridge to decrease the effects of source fluctuations and double the sensitivity. Use of this new method with a tungsten light source resulted in Faraday rotation measurements at the absorption edge of silicon with a precision of ±1.5 minutes at wavelengths down to 1.00μ. The addition of a xenon arc extended the measurements to 0.88μ and still retained a precision of ±1 minute. The described method is limited to the region of transmission of the Wollaston prism. G.G.

N65-26772 Naval Ordnance Lab., Corona, Calif. Infrared Div.
PLASMA AND SPIN RESONANCE IN SEMICONDUCTORS, MEASURED WITH THE VARIAN V-4500 EPR SPECTROMETER

G. Zaeschmar *In its* Foundational Res. Proj. 1 Mar. 1965 p 85–94 refs (See N65-26765 16-26)

Paramagnetic resonance spectrometer measurements of plasma oscillations were used to obtain the carrier concentration values of unpolished InSb samples of approximately 4.3 × 0.8 × 1.3 mm dimensions. The measured values at resonance for an ellipsoid sample with an axial ratio of 1.3/0.8, at 77° K in the H_a direction, were 11 800 G, and for the sample turned around 90° in the cavity with reversed axial ratio of 0.8/1.3 in the H_b direction the values were 6920 G. An attempt to measure the resonance with the long axis of the crystal oriented parallel to the electric field failed. A good agreement between field ratio values measured by the above described method, and those measured by a carrier concentration modulation method was found. G.G.

N65-26773 Naval Ordnance Lab., Corona, Calif. Infrared Div

FLUORESCENCE SPECTRUM OF Pr^{3+} IN LaF_3

H. E. Rast and R. A. Buchanan *In its* Foundational Res. Proj. 1 Mar. 1965 p 95–113 refs (See N65-26765 16-26)

The fluorescence spectra of praseodymium^{3+} in lanthanumfluoride were examined in the spectral region 4600 to 7300 Å when the sample was excited in the levels of $^3P_2$, $^3P_1$, and $^3P_0$. Transitions were observed at levels $^1S_0$, $^1D_2$, $^1G_4$, $^1I_6$, $^3P_{0,1,2}$, $^3F_{2,3,4}$, and at $^3H_{4,5,6}$ with $^3H_4$ being the lowest term. It was found that the 5985Å line of Pr^{3+} in LaF_3 is capable of stimulated emission at 77° K. No efficient transfer of energy to the $4f^2$ levels of Pr^{3+} was observed and the transfer mechanism was reduced by going to lower temperatures. Examination of the irradiated crystals revealed the formation of immobile color centers. It was concluded that the fluorescence of Pr^{3+} was not highly excited. G.G.

N65-26774 Naval Ordnance Lab., Corona, Calif. Infrared Div.

INTERMEDIATE COUPLING ENERGY LEVELS FOR Nd^{3+} ($4f^3$) IN LaF_3

H. H. Caspers, H. E. Rast, and R. A. Buchanan *In its* Foundational Res. Proj. 1 Mar. 1965 p 114–133 refs (See N65-26765 16-26)

The energy levels of neodymium^{3+} in lanthaniumfluoride crystals were experimentally determined from their absorption spectra in the range 4100 to 8000 Å, and the centers of gravity of eight terms were calculated by means of the Taylor series expansion. These values were used to determine the four parameters ΔF_2, ΔF_4, ΔF_6, and $\Delta\zeta$ for which the best agreements were obtained between the calculated free ion and the observed spectrum of Nd^{3+} in LaF_3. Analysis of the fluorescence data at 4.2° K established all the levels of the ground multiplet and established the center of gravity of the $^4I_{9/2}$ as 195.4 cm^{-1}. The set of parameters F_2, F_4, F_6, and ζ that gave the best agreement between the free predicted ion levels and the observed energy levels of Nd^{3+} in LaF_3 is $F_2 = 338.439$ cm^{-1}, $F_4 = 47.153$ cm^{-1} $F_6 = 5.579$ cm^{-1}, and $\zeta = 882.109$ cm^{-1}. G.G

N65-26790 Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

VISCOELASTIC BEHAVIOR INCLUDING NON-LINEAR EFFECTS

E. H. Lee *In its* Bull. of the 3d Meeting Interagency Chem. Rocket Propulsion Group Apr. 1965 p 51–55 refs (See N65-26788 16-27)

A brief review of the theory of nonlinear viscoelasticity is presented, and approaches to simplification of complex mathematical formulas are discussed. Several studies are recommended for application of nonlinear viscoelastic theory to problems of solid propellant grain design. J.M.D.

N65-26857* Naval Radiological Defense Lab., San Francisco, Calif.

THEORETICAL AND EXPERIMENTAL STUDIES OF THE TOTAL EMITTANCE OF METALS

W. J. Parker and G. L. Abbot *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 11–28 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

Equations are presented for the spectral emissivity of metals as a function of angle and plane of polarization based on the Drude free-electron model taking electronic relaxation into account. These equations are integrated to obtain more general expressions than now exist for the total normal and total hemispherical emissivity of metals. Total emittance measurements have been made on tungsten, tantalum, niobium, and molybdenum. These are compared with the theoretical emissivity equations, and a qualitative, but not a quantitative, agreement is found between them. It is necessary to take other factors into account in order to explain the observed emittance data. Author

N65-26858* Little (Arthur D.) Inc., Cambridge, Mass.

FAR-INFRARED SPECTRA OF SOLIDS

James R. Aronson and Hugh G. Mc Linden *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 29–38 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

The techniques and experimental results of a study of the far infrared properties of some solids at temperatures down to 6.5° K are presented. The materials studied include sapphire, quartz, strontium fluoride, barium fluoride, germanium, silicon, stainless steel, chromium, an aluminum alloy, and a magnesium alloy. Author

N65-26859* Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).

EMISSIVITY AND INTER-REFLECTION RELATIONSHIPS FOR INFINITE PARALLEL SPECULAR SURFACES

R. V. Dunkle *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 39–44 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

The ratio between the hemispherical and normal emissivity of a smooth isotropic surface has been found by integration of Fresnel's equations. For materials with an absorption index not equal to zero, the equations involve an approximation. The error introduced by this approximation is negligible at large values of n and k and amounts to only about 1.5 percent when n = 1 and k = 1. The ratio of the hemispherical emissivity factor for radiation exchange between infinite parallel smooth isotropic surfaces to the emissivity factor predicted from normal emissivities has been derived in a similar manner and a curve is presented for the general use of radiation exchange between two surfaces with different optical constants. Author

N65-26867*# National Bureau of Standards, Washington, D.C.

COMMENTS ON THE SURFACE CHARACTERIZATION OF REAL METALS

David P. De Witt *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 141–144 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

Radiation properties of metallic specimens have been shown to be very sensitive to methods of preparation, thermal

history, and environmental conditions. The magnitude, sensitivity, and complexity are illustrated by an example from the literature. An indication of how a real surface might be characterized is discussed in three general categories: topographical characterization, chemical characterization (species present), and physical (or structural) characterization. Author

N65-26868* Naval Ordnance Test Station, China Lake, Calif. Michelson Lab.
INFLUENCE OF SURFACE ROUGHNESS, SURFACE DAMAGE, AND OXIDE FILMS ON EMITTANCE
H. E. Bennett *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 145–152 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

A discussion of the effect of surface roughness, surface damage, and surface films on emittance is given. At wavelengths where diffraction effects predominate, the hemispherical emittance is virtually unaffected by surface roughness. Surface roughness of finished metal surfaces, even those as rough as 60 μin. rms, will not affect the energy radiated by the material at room temperature. The emittance is, however, strongly affected by disorders in the lattice structure at the surface, often called surface damage, which are introduced in the usual finishing operations. It may also be affected by surface films, although naturally occurring oxide films ordinarily have negligible effect at room temperature and below. Author

N65-26869* Lockheed Missiles and Space Co., Palo Alto, Calif.
THE EFFECT OF SLIGHT SURFACE ROUGHNESS ON EMITTANCE
R. E. Rolling *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 153–155 ref (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

Further discussion is given of the emittance of slightly rough surfaces. A published example is cited to show that even where the theory does not agree with the measurements, it does correctly indicate the trends. The case in which the surface is more than slightly rough is also discussed. Author

N65-26989# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
SILICON CARBIDE FOR SEMICONDUCTORS
Gus J. Caras Feb. 1965 201 p refs
(RSIC-381; AD-464777)

This state-of-the-art survey on silicon carbide for semiconductors includes a bibliography of the most important references published as of the end of 1964. The various methods used for growing silicon carbide single crystals are reviewed, as well as their properties and devices fabricated from them. The fact that the state-of-the-art of silicon carbide semiconductors is not further advanced may be attributed to the difficulties of growing single crystals of sufficient size and purity for semiconductor applications. Of the various methods of growing silicon carbide, growth by sublimation appears to be the most successful method. There is considerable variation in the properties of silicon carbide as reported in the literature, mainly because most measurements were conducted on crystals with varying amounts and types of impurities. In the area of devices, rectifiers capable of 500° C operation and unipolar transistors exhibiting power gain at temperatures greater than 500° C have been fabricated. Other devices which have received attention include diodes, photoelectric and electroluminescent devices, and electron emission components. Author

N65-26992# Michigan Univ., Ann Arbor. Infrared and Optical Sensor Lab.
HALL MEASUREMENTS OF THIN LAYERS OF SEMICONDUCTORS
Alfred E. Attard Jun. 1965 23 p refs
(Contract DA-28-043-AMC-00013(E); Proj. Michigan)
(Rept.-6400-38-R; AD-464812)

Hall measurements on thin films via a four-point probe method are described. Basic formulas are derived for an infinite sheet. Modifications of the infinite-sheet formula to correct for boundary conditions imposed by real, finite samples are discussed. Experimental evidence is presented which verifies the theory. Author

N65-27024*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
IMPROVED MAGNETIC COMPONENTS FOR STATIC INVERTERS AND CONVERTERS Sixth Quarterly Report, 27 Sep.–28 Dec. 1964
R. E. Mc Vay et al [1965] 35 p refs
(Contract NAS3-2792)
(NASA-CR-54430; WAED65.6E) CFSTI: HC $2.00/MF $0.50 CSCL 20C

Developments in a program to improve magnetic components for static inverters and converters are presented. The effects of sine flux excitation in the frequency region of 400 cps to 3200 cps on magnetic materials were reviewed. Magnetic properties and physical properties of magnetic materials are being compiled. Conductors and conductor insulations are reviewed. Screening magnetic tests on samples, dc magnetization tests points, and interlaminar insulations are being prepared. Magnetic test equipment was assembled. R.N.A.

N65-27073# Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.
SOLID STATE RESEARCH USING HIGH MAGNETIC FIELDS Final Report, 1 Jul. 1960–31 Oct. 1964
Benjamin Lax and Francis Bitter 15 Feb. 1965 48 p refs
(Contract AF 19(604)-7344)
(AFOSR-65-0733; AD-615152)

A summary of solid state research using high magnetic fields is presented. Included are discussions on magneto-optical studies, magneto-acoustic studies, and magnetic measurements including antiferromagnets, electron paramagnetic resonance, nuclear magnetic resonance, De Hass–Van Alphen studies, Mossbauer effect, and Dirac magnetic monopole. Theoretical studies are presented on band structure of gadolinium metal, nonlinear shielding in rare earth crystal field interactions, electronic polarizabilities and Sternheimer shielding factors, covalency in crystal field theory, spin-orbit coupling in atoms, Bloch electron in a magnetic field, electron gas plasma oscillations in a magnetic field. Also included are discussions on low temperature physics, dc transport measurements, water-cooled magnets, high field superconductors and superconducting magnets, and pulsed magnets. R.N.A.

N65-27086# Harvard Univ., Cambridge, Mass. Cruft Lab.
DIELECTRIC DISPERSION IN FERROELECTRIC ROCHELLE SALT Scientific Report No. 3
Frank Sandy 11 Jan. 1965 185 p refs
(Contract AF 19(628)-3874)
(AFCRL-65-250; AD-615930)

The real and imaginary parts of the dielectric constant of Rochelle salt have been measured at frequencies from 2.5 Gc/sec to 17.12 Gc/sec and at 155 Mc/sec. The measurements were made in the temperature range from −50° C to 45° C which includes both Curie temperatures. Measurements were made both with and without dc biases. The dielectric constant

was found to undergo a relaxation of the Debye type whose relaxation time is proportional to the difference between the low-frequency, clamped, differential dielectric constant and its limiting high-frequency value. It was also found to have a small additional temperature dependence approximately proportional to $T^{5/4}$ and to increase slightly with polarization. Mitsui's model for the ferro-electric effect in Rochelle salt has been extended to cover its high-frequency dielectric behavior and has been shown to be consistent with these experimental results. Author

N65-27152# Harry Diamond Labs., Washington, D. C.
MECHANISM OF HIGH CONDUCTIVITY IN VACUUM-DEPOSITED CADMIUM SULFIDE FILMS
D. W. Readey 2 Mar. 1965 39 p refs
(HDL-TR-1280; AD-615569)

Cadmium sulfide thin films are of interest for various electronic device applications. Films deposited on cold substrates have high conductivities unsuitable for device utilization and must be heat-treated to improve their properties. This investigation was therefore concerned with the high conductivity and phenomena resulting from heat-treatment to elucidate the mechanism that gives rise to them. Based on kinetic measurements made during heat-treatment and other experiments, it is concluded that the high conductivity is caused by a nonstoichiometric excess of cadmium in the films. During heat-treatment, the excess cadmium diffuses to the film surface where it evaporates, with diffusion being the rate-controlling mechanism. Also, the as-deposited films contain a number of electron trapping sites, most of which are annealed out during heat treatment. Author

N65-27184# Texas Instruments, Inc., Dallas.
THIN FILMS FORMED BY ELECTROCHEMICAL REACTIONS Quarterly Progress Report No. 6, 1 Dec. 1964–28 Feb. 1965
Coy D. Orr [1965] 49 p refs
(Contract DA-36-039-AMC-02324(E))
(TI-03-65-35; ECOM-02324-6; AD-615808)

Reactively sputtered thin films of tantalum oxide deposited onto thermally oxidized silicon offer a very wide range of sheet resistivities. The application of an external d-c bias to the substrate during sputtering alters sheet resistivity with no change in film thickness. Resistors of 237 ohms/sq changed less than 3% after 1000 hours at +125° C and 2.5 watts/sq inch. Reactively sputtered Ta_2O_5 dielectric films deposited onto aluminum electrodes offer capacitance values from 0.3 to 3.0 pF/mil^2 and d-c breakdown voltages of 60 to 6 volts, respectively. Yields of 64% within ±20% of 0.5 pF/mil^2 and breakdown voltage greater than 18 volts have been demonstrated. Capacitors tested for 1000 hours at +125° C and 60% of destructive breakdown voltage changed less than 2% from initial capacitance. Author

N65-27193# Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.
GROWTH AND PROPERTIES OF THIN SINGLE CRYSTAL FILMS OF YTTRIUM IRON GARNET Final Report, Mar. 1, 1963–Dec. 31, 1964
Robert C. Linares 31 Jan. 1965 28 p refs
(Contracts AF 19(628)-2796; AF 19(628)-4058)
(M7984; AFCRL-65-128; AD-615016)

Techniques were developed to grow single crystal films of a magnetic garnet (yttrium iron garnet) on a non-magnetic garnet substrate. A number of substrates were investigated, including $Y_3Al_5O_{12}$, $Gd_3Ga_5O_{12}$, and $Y_3(Ga_xIn_{1-x})_5O_{12}$. It was found that $Gd_3Ga_5O_{12}$ (which matches YIG in lattice constant) could be grown as large, relatively perfect crystals by the Czochralski technique. YIG films were grown by flux and vapor deposition. The perfection, optical transmission, surface characteristics, and thickness of these films were investigated. Author

N65-27283# European Atomic Energy Community, Brussels (Belgium).
EFFECTS OF α-PARTICLE IRRADIATION ON THE X-RAY INTENSITIES DIFFRACTED BY GERMANIUM CRYSTALS
R. Colella and A. Merlini 1965 9 p refs Presented at Colloq. on the Effects of Radiation, Paris, 16–18 Jul. 1964
(EUR-2188.e)

On the basis of the dynamical theory of X-ray diffraction, the integrated intensities reflected in the Bragg case by a perfect crystal are, in favorable cases, many times smaller than those reflected by a mosaic crystal. The present investigation was undertaken with the purpose of establishing whether the lattice defects introduced in an initially perfect crystal by energetic particle irradiation affect the values of the X-ray integrated intensities. Nearly perfect germanium single crystals, n-type, with a resistivity of 0.5 Ω-cm, cut with a (111) plane parallel to the surface, were irradiated at liquid nitrogen temperature with the 5.3 MeV alphas of a 0.1 curie Po^{210} source. Maximum irradiation doses were of the order of 10^{15} alphas/cm^2. CuKa radiation reflected by a curved quartz monochromator was used through all the experiments. The integrated intensity of the (333) reflection in the Bragg case increased with irradiation time up to a value 80% higher than the original value before irradiation, although no broadening of the diffracted line was detected by a photographic technique. On the other hand, the intensity of the (111) reflection did not increase appreciably. Also, no decrease in intensity was observed in anomalous transmission at room temperature on the (220) planes perpendicular to the surface. The difference in the behavior of the (111) and (333) reflections might be due to the extinction lengths and to the intervals of total reflection, which are different for the two sets of reflection. The density of the displaced atoms as a function of the penetration depth of the a-particles was calculated by using the Rutherford and hard-sphere scattering laws and the model of Seitz and Harrison. There is no direct correlation between the concentration of the total number of displaced atoms and the observed increase in diffracted intensities. Author

N65-27300# Clevite Corp., Palo Alto, Calif. Shockley Research Lab.
FAILURE MECHANISMS IN SILICON SEMICONDUCTORS Final Report, 1 Mar. 1963–31 Aug. 1964
W. Schroen and W. Hooper, ed. Griffiss AFB, N. Y., RADC, Mar. 1965 311 p refs
(Contract AF 30(602)-3016)
(RADC-TR-64-524; AD-615312)

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N65-27301 Clevite Corp., Palo Alto, Calif. Shockley Research Lab.
FAILURE MECHANISMS IN SILICON SEMICONDUCTORS *In its* Failure Mech. in Silicon Semiconductors, Final Report Mar. 1965 p 1–278 refs (See N65-27300 16-26)

An investigation of the thermal instability in silicon power transistors, and of the damage which occurs in these transistors as a result of hot spots and second breakdown, is presented. Also, the theory of thermal instability is discussed. A study of special transistor structures confirmed earlier theories on thermal instability and shed new light on possible methods by which the failure mode of second breakdown can be minimized. The problem of charge motion on the outer surface of the oxide covering silicon was also studied with emphasis on the current–voltage biased silicon p–n junction. These investigations were directed at a better understanding of the physics of failures which occur in these devices. E.E.B.

N65-27302 Clevite Corp., Palo Alto, Calif. Clevite Semiconductor Div.

CHARGES ON OXIDIZED SILICON SURFACES

W. Shockley, H. J. Queisser, and W. W. Hooper *In its* Failure Mech. in Silicon Semiconductors Mar. 1965 p 279–283 refs (See N65-27300 16-26)

The direct measurements of surface potentials using the Kelvin method are described. The specimens consisted of diffused p–n junction diodes covered with thermally grown oxides between 300 and 1000 A thick. A constant small contact potential was observed across the surface. After applying a reverse bias of +20 V to the n-side, there was a sharp potential drop on the oxide directly above the p–n junction. Results were interpreted as showing that the applied field causes a motion and redistribution of charges on the oxide surface and possibly also within the oxide. The distribution was such as to reduce the external field, i.e., positive charges accumulate on the p-side which is biased negative with respect to the n-side and vice versa. The potential distributions are shown to depend sensitively upon surface treatment and ambient. Further, correlations between surface potential and channel conductance, as well as with breakdown voltage, were observed. The results were in agreement with models ascribing changes in junction behavior to surface charges. E.E.B.

N65-27303 Clevite Corp., Palo Alto, Calif. Shockley Research Lab.

MOBILE ELECTRIC CHARGES ON INSULATING OXIDES WITH APPLICATION TO OXIDE COVERED SILICON p–n JUNCTIONS

W. Shockley, W. W. Hooper, H. J. Queisser, and W. Schroen *In its* Failure Mech. in Silicon Semiconductors Mar. 1965 284–304 refs (See N65-27300 16-26)

The effects of charges on oxide covered silicon surfaces were studied utilizing the Kelvin vibrating condenser method to measure contact potential differences. This technique was used to determine the amount of electrical charges in or on the insulating layer. The results were compared with the values of total charge obtained by integrating ammeter currents. From these experiments it can be concluded that the measured contact potential difference was caused by charges located on the outer surface of the oxide layer. This agrees with the model of surface ion motion proposed previously by Atalla and co-workers. Author

N65-27335# Parke Mathematical Labs., Inc., Carlisle, Mass.

INDIRECT DISPLACEMENT OF ATOMS IN SOLIDS BY KNOCK-ON IMPURITY ATOMS Scientific Report No. 5

Charles H. Sherman Mar. 1965 46 p refs

(Contract AF 19(628)-2419)

(Rept.-2419-SR-5; AFCRL-65-255; AD-615550)

A cascade theory is developed in order to calculate the number of displaced atoms of a host material produced by knock-on impurity atoms. The theory is similar to the Kinchin–Pease cascade theory except that the atom which starts the cascade differs in mass from the other atoms with which it collides. The chief application of the theory is for evaluating the number of host displacements produced indirectly by knock-on impurities in radiation damage experiments. This is of interest as a sub-threshold effect and also as a possible source of error in determining the threshold for atomic displacement. The basic results are evaluated numerically for a wide range of cases which cover most situations of interest in radiation damage experiments. Numerical results are also given for the specific examples of carbon and rhodium impurities in platinum which show that in these cases the number of indirect displacements produced by knock-on impurities is negligible for most purposes. Author

N65-27354 Joint Publications Research Service, Washington, D. C.

ALL-UNION CONFERENCE ON DISLOCATIONS AND MECHANICAL PROPERTIES OF CRYSTALS

M. V. Klassen-Neklyudova *In its* Soviet Conf. on Metals and Met. 8 Jun. 1965 p 41–47 Transl. into ENGLISH from Usp. Fiz. Nauk (Moscow), v. 84, no. 2, Oct. 1964 p 363–365 (See N65-27350 16-26) CFSTI: $2.00

Brief abstracts are given for a few of the articles presented at the conference. Among the subjects covered were the following: mobility of dislocations in crystals; theory of the movements of dislocations; influence of impurities on the mobility of dislocations in crystals; dislocation propagation under conditions of deformation; creep relaxation; and block and twin boundaries. The conference noted the vigorous development of research on the dislocation theory of solid crystal bodies. Further, the conference recognized that insufficient research was being done in the study of the influence of defects on the inhibition of dislocations. E.E.B.

N65-27377*# Naval Ordnance Tests Station, China Lake, Calif.

[THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE PHYSICS OF CRYSTALLINE SURFACES] Quarterly Status Report No. 1, 1 Feb.–30 Apr. 1965

[1965] 3 p

(NASA Order R-05-030-001)

(NASA-CR-63628) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Investigations of the physics of crystalline surfaces were continued. Analytical calculations on the interfacial energy and the nucleation probability were reported, and programming of the formulas was started. Epitaxy experiments with Au on NaCl were performed in an ultrahigh vacuum electron diffraction system with a base pressure of 2×10^{-10} torr, and the results suggest two possible causes for the influence of the history of the surface and of the vacuum conditions on epitaxy. Continued efforts were expended on the problem of reproducing the formation of epitaxial graphite on CaF_2 and Ba_2 by decomposition of CH_4 at temperatures between 800° and 1100° C and pressures from 5×10^{-4} to 1×10^{-3} torr, both in a metal and glass system. Experiments directed toward finding the influence of gas on the nucleation process in crystal growth were continued. In other studies the early states of growth of Ag and Au on a [110] plane of W were studied both in an ultra high vacuum and in a low energy electron diffraction system. L.S.

N65-27520# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Solid State Physics Research Lab.

ELECTRON RADIATION DAMAGE IN ZnSe AT LOW TEMPERATURE

B. A. Kulp and R. M. Detweiler Mar. 1965 33 p refs

(ARL-65-60; AD-615305)

A threshold for radiation damage in ZnSe has been previously reported at 240 keV under electron bombardment. Fluorescence bands at 5460 and 5850 Å are produced. The damage causing these fluorescence bands anneals completely in a single stage at about 130° K. At 10° K somewhat different fluorescence bands are produced. Following heat treatment above 90° K the fluorescence spectrum produced by the 10° K bombardment anneals into that produced by the 80° K bombardment. This indicates that at least one and possibly more of the fluorescence centers observed following bombardment at 80° K is a "complex" center. That is, it is composed of a defect of Zn or Se in association with a foreign impurity. A second threshold for radiation damage in ZnSe has been observed while bombarding at 10° K. This threshold is at 190 keV and is believed to be that for displacement of the Zn atom from the lattice. The 240 keV threshold is therefore associated with displacement of the selenium atom. The displacement energies are 7.6 eV for the zinc and 8.2 eV for the selenium atom. Author

N65-27532# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THEORY AND APPLICATION OF FERRITES AT SUPERHIGH FREQUENCIES

A. K. Mikaelyan 25 Mar. 1965 562 p refs Transl. into ENGLISH of the book "Teoriya i Primeneniye Ferritov Na Sverkhvysokikh Chastotakh" Moscow, Gos. Energ. Izd., 1963 p 1–663
(FTD-MT-64-396)

To provide background information for scientists and engineers working on SHF ferrite devices, solid state physics, and waveguide technology, the theory and application of ferrites at superhigh frequencies is detailed. Among the topics considered are the properties of ferrites, magneto-optical phenomena in ferrites, and the theory of waveguides containing magnetized ferrites. Discussions of phenomena which have practical application include magnetic rotation of plane of polarization in waveguide with magnetized ferrite; nonmutual phase shifters; nonmutual absorption during ferromagnetic resonance; and differences of field structure of forward and reverse waves. Linear ferrite devices at SHF are considered in light of the discussions on phenomena and as related to technological applications. M.W.R.

N65-27536# Texas Instruments, Inc., Dallas.

PRODUCTION ENGINEERING MEASURE TO INVESTIGATE PROPERTIES OF INDIUM ANTIMONIDE AND TO PROVIDE 801-C6 INFRARED DETECTORS Quarterly Progress Report No. 8, 27 Sep.–27 Dec. 1964

H. Duane Adams and William L. Kolander [1964] 17 p refs
(Contract DA-36-039-AMC-01463(E))
(Rept.-03-65-19; AD-614798)

The production phase is in progress with its completion scheduled to occur in March 1965. Due to relocation of facilities a revised delivery schedule was prepared, submitted and approved. Average heat leak change on detectors monitored for 5600 hours is only 0.03 watts; indicative of good vacuum retention. Additional vacuum retention data and electrical parameter information will be obtained in a shelf life test scheduled to start in Febraury. Substrate cooling during placement of cold shields and modified SiO deposition methods have resulted in increased overall yields. Author

N65-27539# Tyco Labs., Inc., Waltham, Mass.

STUDY OF SURFACE STATES IN SEMICONDUCTORS Sixth Quarterly Technical Report, 5 Sep.–4 Dec. 1964

G. Rupprecht and P. H. Smakula Griffiss AFB, N. Y., RADC, Apr. 1965 30 p
(Contract AF 30(602)-3157)
(RADC-TR-65-6; AD-614986)

Surface states on silicon oxidized by both thermal and anodic growth have been studied by two complementary experimental techniques—the pulsed field effect, and capacity measurements over a wide range of frequency and temperature. The two have revealed similar surface levels, and have led to the following conclusions: anodic oxidation creates an inversion layer on N-type silicon, which can be removed by heat treatment; and thermal oxidation leads to increased dislocation density, and results in reduction of the surface state density. Author

N65-27566# Naval Radiological Defense Lab., San Francisco, Calif.

NEAR INFRARED ABSORPTION BAND IN CADMIUM SULFIDE SINGLE CRYSTALS

N. J. Alvares 26 Apr. 1965 30 p refs
(USNRDL-TR-845; AD-465062)

Measurements of the absorption spectra of cadmium sulfide single crystals have been made in the region of 0.5 to 15 microns and between the temperatures of 90° K and 293° K. An absorption peak observed at 3.1 microns is apparently generated by a process of thermal stimulation. It appeared after the crystal was heated from 90° K to 140° K or stored for long periods of time at 90° K. The 3.1 micron absorption peak is an indication of a trapping site with an energy of 0.4 ev. In order to verify this observation, a thermally stimulated current measurement was made with a CdS single crystal. The result of this measurement was that the location of the current peak essentially confirmed the optically observed trapping energy of 0.4 ev. The time response of gamma-induced current for the crystals in a flux of 10 r/hr were measured, and an attempt was made to correlate the time response measurements to the magnitude of the optical absorption peak; however, due to anomalies in the time response measurements, no definite comparisons could be made between these two parameters. The optical observations were able only to detect the presence of the absorption band, and not its energy location within the band structure of the crystal. Author

N65-27620# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.

A STUDY OF X-RAY ABSORPTION EDGE SPECTROSCOPY AS A TOOL FOR SOLID-STATE CHEMICAL RESEARCH Technical Report, Feb. 1, 1964–Jan. 31, 1965

Armand J. Panson 31 Jan. 1965 19 p refs
(Contract Nonr-4463(00))
(TR-1; AD-610719)

The usefulness of X-ray absorption edge spectroscopy as a tool for determining valence, bond type, and coordination is studied. New transistorized electronic components were installed in the detection system of a spectrometer. The instrument was improved to include pulse height analysis on both monitor and detector proportional counters, and test measurements indicate that the monitored beam arrangement is functioning properly with respect to elimination of errors due to intensity fluctuations. Since most of the compounds to be studied will be in powder form, techniques for preparing such absorber specimens were developed and tested. Copper compounds were used. For room temperature studies, suitable absorbers were prepared by casting powders in polystyrene films. For higher temperatures a silicone varnish, stable in air for extended times at 550° C, was found to be a suitable transparent temperature-stable substrate. Preliminary spectra were obtained for a series of divalent copper compounds, and

are graphically presented. A supporting study of soft X-ray emission spectra of cobalt and oxygen in $LaCoO_3$ was initiated. L.S.

N65-27667# Alfred Univ., N. Y.
SEMICONDUCTING MATERIALS. PART II: AN INVESTIGATION OF THE BORON–PHOSPHORUS SYSTEM Final Report
15 Jan. 1965 266 p refs
(Contract Nonr-1503(01))
(AD-610382)

A series of compositions, including pure $B_{13}P_2$, was examined for Knoop hardness, electrical conductivity, activation energies, thermal conductivity, thermoelectric power, density, Hall effect, and magnetoresistance. It was concluded that: (1) The composition $B_{13}P_2$ is not as good a thermoelement as $B_{13}C_2$. (2) The conduction mechanism in $B_{13}P_2$ is of mixed polarity and probably involves a surface inversion effect and multiple extrinsic levels. The electrical conductivity of pure $B_{13}P_2$ is four to seven orders of magnitude below that of $B_{13}C_2$ from 190° K to 1000° K. (3) The hardness of $B_{13}P_2$ is only slightly less than that of $B_{13}C_2$. (4) Although carbon is the major impurity in the born subphosphide samples, pure $B_{13}P_2$ powders and theoretical density compacts of high purity can be prepared. E.E.B.

N65-27690*# National Aeronautics and Space Administration, Washington, D. C.
AMPLIFICATION OF THE INFLUENCE OF EXTERNAL EFFECTS BY A p–n JUNCTION [OB USILENII EFFEKTOV VNESHNIKH VOZDEYSTVIY p–n–PEREKHODOM]
Yu. F. Sokolov Jun. 1965 8 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 10, Jan. 1965 p 195–198
(NASA-TT-F-9435) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Discussion of some results obtained by Stafeev which show that, if the current-carrier mobility in a semiconductor is changed by an external effect, the relative change in the current ($\Delta j/j$) flowing through a p–n junction with a thick base and the relative change in semiconductor conductivity ($\Delta\sigma/\sigma$) are related by the expression $\Delta j/j = K(\Delta\sigma/\sigma)$ where the amplification factor K is larger than unity. A formula for the maximum value of K is derived. Author

N65-27701*# National Aeronautics and Space Administration, Washington, D. C.
ELECTROSTATIC EMISSION OF ELECTRONS FROM SILICON [ELEKTROSTATICHESKAYA EMISSIYA ELEKTRONOV IZ KREMNIYA]
O. D. Protopopov Jun. 1965 20 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), v. 8, no. 4, 1964 p 62–72
(NASA-TT-F-9404) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Determination of the volt-ampere characteristics for electrostatic electron emission of silicon. The characteristics, represented graphically, are generally straight lines tending to deflect at high voltages. A desorption technique is used to obtain clean silicon emitter surfaces which permit a qualitative comparison of experimental data with theoretical figures and reduce the probability of boron diffusion. A model of "heating" of the electron gas is used to clarify the behavior of the volt-ampere characteristics at high voltages. Author

N65-27702*# National Aeronautics and Space Administration, Washington, D. C.
THE OPTICAL CHARACTERISTICS OF ABSORBING MEDIA IN THE INFRARED REGION USING THE MODEL OF A RESONATOR WITH VISCOUS FRICTION [PREDISTAVLENIYE OPTICHESKIKH KHARAKTERISTIK POGLOSHCHAYUSHCHIKH SRED V INFRAKRASNOY OBLASTI NA OSNOVE MODELI REZONATORA S VYAZKIM TRENIYEM]
L. D. Kislovskiy Jun. 1965 24 p refs Transl. into ENGLISH from Opt. i Spektroskopia (Moscow), v. 1, no. 5, 1956 p 672–684
(NASA-TT-F-9405) CFSTI: HC $1.00/MF $0.50 CSCL 20L

The classical model of a resonator with viscous friction is used for construction of a corrected resonance curve of continuous bands of strong absorption in crystals. A method of construction of a spectral curve of reflection from three of its values, based on the assumption of correspondence of amplitudes and phases of forced oscillations and reflection, is proposed. The optical constants n and k are determined graphically from the corrected resonance curve. In the case of continuous bands of strong absorption a combination of the suggested method with the Robinson–Bode method permits making the determination of the phase of the forced oscillations more precise, and also allows for discrepancies caused by schematism of the model used. Comparison of some calculated data with the experimental data for a number of alkali halide crystals showed satisfactory agreement. Author

N65-27717*# National Aeronautics and Space Administration, Washington, D. C.
BREAKDOWN IN NARROW SILICON p–n JUNCTIONS [PROBOY v UZKIKH KREMNIYEVYKH P–N–PEREKHODAKH]
V. K. Aladinskiy Jun. 1965 19 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 10, no. 1, 1965 p 102–111
(NASA-TT-F-9433) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Breakdown is investigated in step-type silicon p–n junctions having a width from 10^{-6} to 10^{-4} cm. It is demonstrated experimentally that in such junctions there exist simultaneously two breakdown mechanisms: tunnel and impact ionization, the interaction of which leads to sign reversal on the part of the temperature coefficient of the breakdown voltage and causes the differential impedance of the p–n junctions to vary sharply with temperature. It is established that the curve for the dependence of the differential resistance and temperature coefficient of the breakdown voltage on the breakdown voltage has a critical point, characterizing the onset of impact ionization by tunneling carriers. The threshold energy value for formation of electron-hole pairs by electrons is determined, and turns out to be 2.6 ±0.3 ev. The experimental results are in qualitative agreement with the simple theoretical model. Author

N65-27718*# National Aeronautics and Space Administration, Washington, D. C.
THE GENERATION OF ELECTRICAL OSCILLATIONS IN CADMIUM SULFIDE MONOCRYSTALS [IZSLEOVANE VURKHU GENERATSIITE NA ELEKTRICHII TREPTENIYA V MONOKRISTALI OT KADMIEV SULFID]
St. Kunev, Kr. Marinova, and N. Zhilov Jul. 1965 12 p refs Transl. into ENGLISH from Izv. Fiz. Inst. s Aneb. Bulgar. Akad. Nauk. (Sofia), v. 12, no. 1 and 2, 1964 p 5–12
(NASA-TT-F-9434) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Results of tests on the appearance of electric oscillations in cadmium sulfide monocrystals show that irradiation of the crystals with infrared light affects appearance, form, and amplitude of current oscillations. Two types of crystals result: those with linear volt-ampere characteristics, and those with saturable volt-ampere characteristics. Author

N65-27719*# National Aeronautics and Space Administration, Washington, D. C.
PROBLEM OF THE TEMPERATURE DEPENDENCE OF THE BREAKDOWN VOLTAGE IN SILICON p–n JUNCTIONS [K VOPROSU O TEMPERATURNOY ZAVISIMOSTI PROBIVNOGO NAPRYAZHENIYA v KREMNIYEVYKH p–n–PEREKHODAKH]
V. K. Adalinskiy Jun. 1965 6 p refs Transl. into ENGLISH from Radiotekhn. i Elektron (Moscow), v. 10, Jan. 1965 p 201–203
(NASA-TT-F-9436) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Development of an approximate method for calculating the breakdown voltage for a fast-rise and a linear p–n junction in silicon. A graph showing the calculated and experimental curves expressing the temperature coefficient as a function of the magnitude of the breakdown voltage for the two p–n junctions is presented. Author

N65-27746# International Business Machines Corp., Yorktown Heights, N. Y. Thomas J. Watson Research Center
PHONON INTERACTIONS IN CRYSTALS Quarterly Technical Report, 15 Nov. 1964–14 Feb. 1965
N. S. Shiren, M. Pomerantz, and R. J. von Gutfeld [1965] 58 p refs
(Contract DA-36-039-AMC-02280(E))
(QTR-7; AD-615960)

A quantitative theory of adiabatic fast passage in S = 1 systems is presented. This theory supports the qualitative arguments previously given to explain the experimental maser results. In addition, the theory explains the dynamic gain mechanism, which is shown to be stimulated phonon–photon double quantum emission. The attenuation of 9-Gc phonons in phosphorous-doped Ge has been measured. According to the proposed theory of attenuation caused by bound electrons in degenerate states, the attenuation of the shear wave in the (100) direction should show a maximum at about 20° K. The observed attenuation shows a maximum at about 15° K, which is a qualitative confirmation of the theory. The implications of this attenuation mechanism for the thermal conductivity of doped Ge and Si are considered. Data are presented on the values of the acoustic energy velocity for quartz, sapphire, NaCl and KI. The experimental values have been determined by a special geometrical construction given by Musgrave and allow the construction of energy velocity surfaces. These energy velocity surfaces give values of the velocity that agree to within 5 percent of the observed heat pulse velocities. The multivalued nature of the energy surface is also discussed and shown to be in good agreement with the heat pulse experiments. Author

N65-27770*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE ROTATING SUPERCONDUCTOR. PART II: THE FREE ENERGY
M. M. Saffren 14 May 1965 16 p refs
(Contract NAS7-100)
(NASA-CR-63687; JPL-TR-32-650(Pt.II)) CFSTI: HC $1.00/MF $0.50 CSCL 20L

In this Report, we derive the free energies appropriate for stationary and rotating superconductors with and without an external applied field. A general theorem is deduced that determines the fluxoids of a multiply connected superconductor in its equilibrium state. Also shown is that an isolated stationary superconductor rotates when made superconducting in an external field. This is an effect that has not been noticed previously. While we derive free energies from the point of view of London theory, which is to treat the superelectrons as having a uniform density, we show that even from the point of view of the Ginzburg–Landau theory, in which this restriction is not imposed, our conclusions are essentially unaltered. In the derivation of the free energies, an expression for the magnetic enthalpy is required. This expression is obtained in a novel way through use of the concept of a "magnetic reservoir." Author

N65-27773# Bureau of Mines, Rolla, Mo.
INTERNAL FRICTION AS A FUNCTION OF ORIENTATION IN MAGNESIUM SINGLE CRYSTALS
Robert R. Nothdurft and A. E. Schwaneke 1965 22 p refs Prepared in cooperation with Missouri School of Mines and Met., Rolla
(BM-RI-6642)

The internal friction of eight single crystals of magnesium with orientation ranging from 10° to 84° was measured at 33.5 kc and 272° C, and the results were interpreted in terms of the pinned-dislocation model proposed by Granato and Lücke. Results show that the strain-amplitude-dependent decrement varies with orientation in a manner predictable by the G-L model. Different values of strain-amplitude-independent decrement were observed at different orientation angles, but correlation with the theory was not conclusive. Author

N65-27796# Harvard Univ., Cambridge, Mass. Cruft Lab.
PARAMAGNETOELECTRIC EFFECT IN $NiSO_4 \cdot 6H_2O$
Shou-Ling Hou 17 Nov. 1964 126 p refs
(Contract Nonr-1866(16))
(TR-458; AD-610688)

Results of an experiment on $NiSO_4 \cdot 6H_2O$ crystal verify the existence of an electric polarization induced solely by magnetic fields. The existence of an induced magnetic moment due to the combined influence of an applied electric field and a dc magnetic field was also detected. The spin Hamiltonian in the presence of the electric and magnetic fields was derived. A phenomenological theory, using the spin Hamiltonian formalism, was developed to obtain the coefficient of paramagneto-electric effect. The magnetic susceptibilities parallel and perpendicular to the crystal c-axis were measured using an ac balanced magnetometer, and the electron spin resonance at 30 kmc/sec was also observed with a dc magnetic field applied along the c-axis in order to obtain the parameters of the spin Hamiltonian of Ni^{++} ion. J.M.D.

N65-27804# Linde Co., Indianapolis, Ind. Speedway Labs.
SYMMETRICAL LASER CRYSTALS Semiannual Technical Summary Report, 1 May–31 Dec. 1964
H. Fay, C. D. Brandle, and O. H. Nestor 28 Jan. 1965 68 p refs
(Contract Nonr-4131(00); ARPA Order 306-62; Proj. Defender)
(SRCR-65-2; AD-610608)

The stated objective of this investigation is the growth of cm^3-sized crystals of cubic perovskites of type $A^{II}B^{IV}O_3$ activated with divalent or tetravalent dopant cations. Cubic perovskites should be desirable host crystals for "laser" dopant ions. A longer fluorescent lifetime is anticipated when the dopant is at a center of symmetry. Only four II-IV perovskite oxides have been proven to be cubic; they are $SrTiO_3$, $SrSnO_3$, $BaSnO_3$ and $BaZrO_3$. $BaZrO_3$ is predicted to be the best choice for doping with divalent rare-earth ions because the zirconium compound is more stable toward reduction. The synthesis of both $SrTiO_3$ and $BaZrO_3$ has been investigated in this program. A self-containment or "skull-melting" have been studied both theoretically and experimentally. Stable melts of as much as 3 kg of both compounds have been made and controlled. Pulling experiments with $SrTiO_3$ have shown that the basic operations of the Czochralski method may be performed with skull-melts. Polycrystalline masses of $SrTiO_3$ have been "pulled" after nucleation on an iridium rod. Author

N65-27833# Illinois Univ., Urbana. Dept. of Electrical Engineering.

JUNCTION EFFECTS IN COMPOUND SEMICONDUCTORS

N. Holonyak, Jr., M. D. Sirkis, C. J. Nuese, and C. M. Wolfe Mar. 1965 15 p refs
(Contract AF 19(628)-4337)
(AFCRL-65-271; AD-616002)

Work is described which indicates major progress has been achieved by extending to binary and ternary III-V compounds, i.e., to GaP and GaAsP, the vapor-liquid-solid (VLS) growth mechanism demonstrated recently in silicon by Wagner and Ellis. This has made possible the growth of dislocation-free III-V compounds and helps elucidate the mechanisms controlling the growth of these complicated materials. Further effort has been expended and progress achieved in the synthesis of laser-quality GaAsP. The effects of doping impurities on growth of single crystal GaAsP are mentioned. The dislocation densities observed are also mentioned. The properties of lasers fabricated to date in this program are tabulated. The behavior of threshold current in a certain crystal as a function of Fabry–Perot reflector spacing is presented. The current state of electron bombardment experiments is outlined. Author

N65-27843# Mallory (P. R.) and Co., Inc., Burlington, Mass. Lab. for Physical Science.

INVESTIGATION OF ULTRA HIGH VACUUM SPUTTERED THIN FILMS Scientific Report No. 3

George Wallis and Ernest Pittelli 30 Apr. 1965 31 p refs Submitted for Publication
(Contract AF 19(628)-3840)
(AFCRL-65-345; AD-615971)

Minor modifications in the construction of the vacuum chamber and changes in the outgassing schedule have been made in order to reduce background pressure during sputtering. Single crystal sapphire and calcium fluoride have been added to the substrate materials under investigation. Thick films with improved structural and electrical characteristics have been grown. A paper has been completed on the electrical characteristics of vacuum deposited germanium films. The paper which is included in this report attempts to account quantitatively for the electrical behavior of the films. Author

N65-27845# Cornell Univ., Ithaca, N. Y. Electrical Engineering Research Lab.

INVESTIGATION OF LINEAR BEAM AND NEW CONCEPTS OF MICROWAVE POWER. VOLUME VI: LASER-STIMULATED ELECTRON EMISSION

L. A. Mac Kenzie and D. M. Stevenson Griffiss AFB, N. Y., RADC, Apr. 1965 167 p refs
(Contract AF 30(602)-3243)
(RADC-TR-64-563, Vol. VI; AD-616001)

The diffusion of time-varying magnetic fields through conductors is examined, and the quantitative results are applied to pulsed solenoids to obtain the axial magnetic fields produced by these devices. Based upon these results a design procedure is established for simple pulsed solenoids. A trial design and its experimental results are presented for comparison with the theory. An experimental study was made of emission of electrons from one side of a thin tungsten ribbon when heated by laser irradiation from a pulsed ruby laser incident on the opposite side. The emission obtained in this way was found to be repeatable up to current densities of 400 a/cm^2. Beams with this current density and diameters of 0.005-in. were focused using magnetically confined flow in a pulsed magnetic field. The optical properties of tungsten and beam focusing using magnetic fields are discussed. N.E.A.

N65-27887# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

X-RAY DIFFRACTION STUDIES OF THERMAL MOTIONS IN CRYSTALS Special Report

R. A. Young 2 Nov. 1964 4 p refs
(Contracts Nonr-991(00); Nonr-991(06))
(AD-610811)

Technical activities involved in a diffraction study of thermal vibrations in crystals are discussed briefly. Also, a current hypothesis in a study of the temperature dependence of the integrated Bragg intensity from nearly perfect crystals, and the use of X-ray diffraction topography to assay the perfection of crystals used in the study, are discussed. J.M.D.

N65-27888# Monsanto Research Corp., Everett, Mass. Boston Lab.

WIDE BAND GAP SEMICONDUCTORS Final Report

D. E. Hill and R. I. Steerns 30 Jun. 1964 35 p refs Prepared for Lincoln Lab., MIT
(Contract AF 19(628)-500)
(AD-610629)

Preparation and physical preparation of the wide gap III-V semiconductor compounds were studied in the interest of finding compounds suitable for fabrication into electroluminescent diodes. Methods and difficulties in preparing compounds of the class consisting of cubic BP, BAs, AlP, and AlAs are described. From studies of physical properties, tabular data are given on ternary Ni-B-P compositions completely liquefied under 1200° C, attempts to dope boron phosphide, and electronegativity differences, band gap, and single bond energy values of III-V and IV semiconductors. J.M.D.

N65-27901# Northwestern Univ., Evanston, Ill. Materials Research Center.

MATERIALS RESEARCH CENTER ANNUAL REPORT, 1 FEB. 1964–31 JAN. 1965

[1965] 134 p refs
(Contract ARPA SD-67)
(AR-5; AD-462975)

The materials research program is discussed and abstracts are presented on mechanical, chemical, physical, and electric properties of materials. Among the subjects covered are the following: internal friction by thermoelastic coupling in polycrystalline materials; synthesis and properties of organometallic compounds; theory of transport and other properties of metals and plasmas; structure sensitive properties of solids; microwave investigation of semiconductors and magnetic materials; optical and electrical properties of compound semiconductors; diffraction studies of materials; polymer studies; semiconductor properties of gray tin; properties of high-temperature materials; thin films and superconductors; ultra-thin metal crystals; sintering kinetics; anisotropic semiconductors; lattice imperfections; band structure of semiconductors and theory of superfluids; determination of Fermi surfaces; solid state nuclear resonances; thermodynamic properties of solids; and electronic structure and thermodynamics of alloys and semiconductors. E.E.B.

N65-27935# Alfred Univ., N. Y. Coll. of Ceramics.

THE THERMAL-MECHANICAL BEHAVIOR OF STRONTIUM ZIRCONATE Bimonthly Progress Report, 1 Oct.–1 Dec. 1964

J. E. Funk, J. Nemeth, and J. R. Tinklepaugh [1964] 14 p refs
(Contract NOw-65-0131-d)
(BMPR-1; AD-610480)

Most of the research on strontium zirconate has been concerned with its room temperature properties. The period of this report was largely devoted to the design of equipment for the study of the stress-strain behavior and crystal

structure at elevated temperatures. It is possible that the permanent deformation observed in polycrystalline strontium zirconate may be enhanced by solid solution with calcium zirconate. Such solid solutions were prepared for testing. Author

N65-27969# Stanford Univ., Calif. Microwave Lab.
MICROWAVE RESEARCH Quarterly Status Report No. 24, 1 Nov. 1964–31 Jan. 1965
M. Chodorow [1965] 14 p refs
(Contract Nonr-225(48))
(ML-1316; AD-614099)

Microwave studies were continued. A program for determining properties of ZnO crystals was initiated for studying the microwave region of acoustic wave amplification in piezoelectric semiconductors. Detailed temperature dependence measurements of the line positions of absorption transitions of Nd^{3+} in the hard LaF_3 lattice were continued for improving the performance of optical masers. The use of a bleachable absorber as the Q-switching element is being evaluated in the development of a tunable laser, and instrumentation for studying attenuation of ultrasonics at low temperatures was completed. The relation between energy transport velocity, group velocity, and attenuation in CdS crystals is being investigated in research on geometrical optics of acoustic waves. Studies were initiated on oscillations in semiconductors, and on plasma effects in solids. L.S.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-26788# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
BULLETIN OF THE 3RD MEETING OF THE INTERAGENCY CHEMICAL ROCKET PROPULSION GROUP, WORKING GROUP ON MECHANICAL BEHAVIOR, VOLUME III
Apr. 1965 101 p refs Meeting held at Redstone Arsenal, Ala., 17–19 Nov. 1964
(Contract NOw-62-0604-c)
(CPIA Publ.-61-A; AD-463151)

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12. A CUMULATIVE DAMAGE CONCEPT FOR PROPELLANT LINER BONDS AND ITS APPLICATION TO FULL-SCALE MOTORS K. W. Bills, Jr., B. B. White, and R. W. Planck p 57–64 refs (See N65-26791 16-27)

13. CHEMORHEOLOGICAL STUDIES OF CARBOXY-TERMINATED POLYBUTADIENE TYPE BINDER P. C. Colodny, L. A. Waddle, and J. S. Wood p 65–83 refs (See N65-26792 16-06)

14. AN OPTICAL SCANNING SYSTEM FOR MULTI-AXIAL STRAIN MEASUREMENTS C. C. Surland and G. R. Givan p 85–99 ref (See N65-26793 16-14)

N65-26789 Office of Naval Research, Washington, D. C.
PROGRESS IN THE NAVY RESEARCH PROGRAM ON THE MECHANICAL BEHAVIOR OF SOLID PROPELLANT GRAINS. PART I: THE ONR CONTRACT PROGRAM. PART II: THE NAVY "IN-HOUSE" PROGRAM
J. M. Crowley and J. G. Tuono (Naval Propellant Plant) *In* APL Bull. of the 3d Meeting Interagency Chem. Rocket Propulsion Group Apr. 1965 p 3–19 refs Prepared jointly with Naval Propellant Plant (See N65-26788 16-27)

Current work in numerous contracts in this study of solid propellant grains are summarized. Reports concern rheological evaluation of elastomers, mechanical properties of viscoelastic materials cast in various forms, properties of wire-reinforced propellants, and design criteria for solid propellant rocket motor grain configurations. J.M.D.

N65-26791 Aerojet-General Cyrp., Sacramento, Calif.
A CUMULATIVE DAMAGE CONCEPT FOR PROPELLANT LINER BONDS AND ITS APPLICATION TO FULL-SCALE MOTORS
K. W. Bills, Jr., B. B. White, and R. W. Planck *In* APL Bull. of the 3d Meeting Interagency Chem. Rocket Propulsion Group Apr. 1965 p 57–64 refs (See N65-26788 16–27)

An experimental and analytical study has been performed to apply a cumulative-damage concept to the prediction of the useful life of the propellant-liner bond in certain stored solid propellant motors. Laboratory measurements gave the linear relationship between log constant tensile stress and log time to failure for thin (0.25 in.) propellant-liner test specimens. A structural analysis provided the maximum tensile and shear stresses that were generated by cooling the motor from the cure temperature to 60° F and by gravitational forces. From the maximum principal stresses in the motor and the time-to-failure data on the test specimens, damage ratios were computed and accumulated using Miner's relation. From the damage ratios, predictions were made of the storage life of these motors before bond failures would lead to motor rejections. After a minor revision of stress levels, excellent agreement was found between predicted failures and failures observed in periodic gammagraphic examination of many stored motors of this type. Author

N65-26934# Naval Propellant Plant, Indian Head, Md. Production Dept.
INDUSTRIAL PREPAREDNESS MEASURE: STUDY OF IMPROVED METHODS OF DRYING CASTING POWDER
J. E. Geist 25 Mar. 1965 130 p
(AD-464534)

Four methods of drying casting powder were studied, namely "sweetie" barrel, bed drying, Roto-louvre, and dielectric. Of the methods studied, the dielectric drying offers the most advantages in regard to safety, adaptability to remote and continuous processing, drying time, and operating cost. Estimated annual savings of $178,260 may be obtained by using dielectric drying in place of the present dryhouse method. Author

N65-27009 Air Force Systems Command, Edwards AFB, Calif. Air Force Rocket Propulsion Lab.
AIR FORCE REQUIREMENTS FOR PROPELLANTS
Don A. Hart *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 4 p (See N65-27000 16-34)

Some of the past deficiencies of solid and liquid propellants that represent present requirements as a result of the need for correcting or eliminating these deficiencies are discussed. Outstanding among the requirements listed for both liquid and solid propellants was that of propellant usability. The influence of future mission on both solid and liquid propellant requirements is examined. N.E.A.

N65-27286# Stanford Research Inst., Menlo Park, Calif.
HIGH ENERGY OXIDIZERS IN SOLUTION Technical Progress Report (Quarterly), Jan. 1–Mar. 31, 1965
W. E. Tolberg, R. S. Stringham, R. T. Rewick, and M. E. Hill 30 Apr. 1965 19 p refs
(Contract AF 04(611)-9370; ARPA Order 24)
(TPR-7; AD-463875)

During the past quarter, solubility relationships in the $F_2/NF_3/HF$ system have been determined and the interaction of SbF_5 with this system has been studied by means of NMR spectra. Contrary to previous results, the solubilities in the $F_2/NF_3/HF$ system have been found to follow ideal behavior in mixtures of F_2 and NF_3 as well as individually. Thus the apparent interaction previously reported does not exist at a temperature of 20° C. The NMR spectra of the $F_2/NF_3/HF/SbF_5$ system show that NF_3 is not consumed to form the hypothetical NF_x^+ cations. The F_2 resonance disappears on standing, possibly through reaction with the fluorocarbon container. The F^{19} NMR spectrum of the HF/SbF_5 system contains a set of three multiplet lines which have tentatively been attributed to the structure $Sb_2F_{11}^-$. Author

N65-27842# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
CONTINUOUS MEASUREMENT OF SOLID PROPELLANT BURNING RATES Annual Report
J. R. Osborn, R. J. Burick, and P. Y. Ho Feb. 1965 57 p refs
(Grant AF-AFOSR-207-64)
(JPC-405; I-65-2; AD-616098)

The basic operating principles of an experimental system for the direct and continuous measurement of solid propellant burning rates are presented. Several components of the measurement system have been modified in order to increase the precision of the burning rate measurements. A continuous burning rate measurement technique, termed the Servo-mechanism Technique, will be employed for obtaining erosive burning rate data for types BDI and BUU double-base propellants. Burning rate measurements will be made with different gas flow velocities parallel to the burning propellant surface. A feasibility study was conducted for determining the adaptability of microwave techniques to the measurement of the burning rate of a solid propellant. Because of the dependence of the microwave attenuation upon the combustion conditions present in a research rocket motor, microwave techniques are not readily adaptable to burning rate measurements. A feasibility study indicates that a technique employing ultrasonic pulses can be developed for obtaining direct measurements of the burning rate of a solid propellant. Author

N65-27959*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
LIQUID PROPELLANTS SAFETY HANDBOOK
George T. Carter 1 Apr. 1965 106 p refs
(NASA-TM-X-56611; SP-4-44-S) CFSTI: HC $4.00/MF $0.75 CSCL 21I

Presented is a safety handbook which was designed for personnel involved in handling liquid propellants. Included are data on the description and properties of liquid propellants, storage facilities, firefighting facilities, storage and transfer of liquid propellants, spills, leaks and decontamination, and disposal of liquid propellants. Among the liquid propellant fuels and oxidizers considered are: ethyl- and furfuryl-alcohol, anhydrous ammonia, aniline, ethylene oxide, liquid fluorine, hydrazine, hydrocarbons, liquid hydrogen, hydrogen peroxide, nitric acids, nitrogen tetroxide, liquid oxygen, unsymmetrical dimethlhydrazine (UDMH), UDMH, and UDMH/hydrazine mixture. Data on the physiological effects of these propellants are also included. S.C.W.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-27399*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF ATLAS SOLID FUEL RETARDING ROCKET DURING ATLAS-CENTAUR SEPARATION TESTS
Richard W. Heath, Henry Synor, Ralph F. Schmiedlin, and John H. Povolny Washington, NASA, Jul. 1965 21 p refs
(NASA-TM-X-1119) CFSTI: HC $1.00/MF $0.50 CSCL 21H

During the course of the Atlas-Centaur separation tests in the Lewis Space Power Chamber recurrent failures were experienced in the firings of the Atlas retarding rockets. In an effort to evaluate the suitability of these rockets for flight use, an investigation into the primary cause for the misfires was instituted and an evaluation of the performance of the rockets was made. The primary cause of the failures of the rocket to ignite was inconsistent igniter functioning and a too short igniter burning period. Author

N65-27507 Boeing Scientific Research Labs., Seattle, Wash.
ACCELERATORS
Gordon C. Oates (MIT) and J. Kenneth Richmond *In its* Rev. of Magnetofluiddyn. Appl. Apr. 1965 p 33–78 refs (See N65-27505 16-25)

Difficulties and fundamental engineering limitations in electric propulsion device research are discussed. An attempt is made to delineate clearly the present limitation, and determine, if possible, whether such limitations are truly fundamentally limiting, or whether future development should hold hope of significant engineering progress. The discussion is restricted to magnetofluiddynamic devices, and hence considers electrothermal and electrostatic propulsive devices only by way of comparison. N.E.A.

N65-27515*# IIT Research Inst., Chicago, Ill. Technology Center
PROTECTIVE COATING FOR REFRACTORY METALS IN ROCKET ENGINES Supplemental Report, Mar. 8, 1963–Mar. 15, 1964
18 Mar. 1965 19 p refs
(Contract NAS7-113)
(NASA-CR-63661; IITRI-B237-25) CFSTI: HC $1.00/MF $0.50 CSCL 21H

A series of coated refractory metal nozzles were evaluated as radiation-cooled components in a rocket test engine. The coating systems included silicides, silver-silicide mixtures, hafnium nitride, W–Hf alloy, and graded HfO_2–$SrZrO_3$–W composite coatings. A mixture of 50 wt.% N_2H_4 and uns-dimethylhydrazine fuel was used with N_2O_4 oxidizer operating at an oxidizer to fuel ratio of 1.6. The nozzles were fired at sea level at a chamber pressure of 150 psia. The firing conditions were established to produce a wall temperature approximately 4200° F at the surface of the coatings. The nozzle coating test results are tabulated. R.N.A.

N65-27626# International Business Machines Corp., Owego, N. Y. Space Guidance Center.
OPTIMALITY OF INTERMEDIATE-THRUST ARCS OF ROCKET TRAJECTORIES
H. M. Robbins Sep. 1964 25 p refs
(IBM-64-825-1185)

A new necessary condition is derived for the optimality of intermediate-thrust arcs of rocket trajectories in vacuum. The new necessary condition, together with previously known necessary conditions, ensures the absolute optimality of "sufficiently short" intermediate-thrust arcs. For inverse-square central fields, the new condition reduces to a requirement that the primer-vector must point inward; its radial component must be negative. Intermediate-thrust arcs which satisfy the new condition cannot join to arcs of a finite maximum thrust, nor join directly (without impulses) to arcs of zero thrust, except in a very restricted set of special cases. They are, therefore, of theoretical rather than practical importance. Author

N65-27691*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
CYCLOTRON RESONANCE PROPULSION SYSTEM Semi-annual Report No. 1
David B. Miller and George W. Bethke 17 May 1965 72 p refs
(Contract NAS3-6266)
(NASA-CR-54213; GE-214-252(1 SAR)) CFSTI: HC $3.00/MF $0.75 CSCL 21C

Two cyclotron-resonance plasma accelerators have been built. Both are of the longitudinal-interaction type, and each has a 1.152 inch inside diameter. One features axial injection of the propellant through a hole in the waveguide window. Peripheral injection is employed in the other. A total calorimeter, an array of diode probes, an energy analyser, and potential probes have to date been employed to study the exhaust stream. The axial injection accelerator has been shown to have relatively low power efficiency (a maximum of 42% of the r-f power was observed in the exhaust stream) and the window design is not structurally adequate. Preliminary diode probe array studies of the peripheral injection accelerator indicate that the efficiency may be better. The energy analyser probe has shown that the ions have mean energies of 57-197 ev with spreads of ±15-35%. Author

N65-27963# Naval Ordnance Test Station, China Lake, Calif. Engineering Dept.
CHAR DEPTH IN NOZZLE INSERTS
Elder H. Bartel Jan. 1965 26 p refs
(NAVWEPS-8539; NOTS-TP-3548; AD-614260)

Fiber-reinforced plastic moldings were tested as nozzle inserts in a solid-propellant rocket motor. Results obtained are tabulated and discussed as to erosion resistance and char-forming characteristics of the materials tested. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-26775# Case Inst. of Tech., Cleveland, Ohio.
PROCEEDINGS OF CONFERENCE ON THE INTERACTION BETWEEN COSMIC RAYS AND HIGH ENERGY PHYSICS
L. Jones, A. Pevsner, and F. Reines, ed. [1964] 230 p refs Conf. held at Case Inst. of Tech., Cleveland, 25–26 Sep. 1964
(Grant Nonr(G)-00034-65)
(AD-613611)

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7. EXPERIMENT TO DETECT BASIC TRIPLETS M. Schwartz (Columbia Univ.) 4 p (See N65-26782 16-28)
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21. OPTIMUM DESIGN OF MAGNETIC SPECTROMETERS R. W. Thompson, R. Streitmatter, and Thomas G. Morrison 1 p

22. A SEARCH FOR INTERACTIONS PRODUCED BY COSMIC RAY NEUTRINOS F. Reines, T. L. Jenkins, M. F. Crouch (Case Inst. of Tech.), and J. P. F. Sellschop (Witwatersrand Univ.) 5 p refs (See N65-26785 16-29)

23. PROPOSAL FOR HIGH ALTITUDE PARTICLE PHYSICS EXPERIMENT L. W. Alvarez and W. E. Humphrey (California Univ.) 46 p refs (See N65-26786 16-29)

24. DETAILED PARAMETERS OF JONES' PROPOSAL 12 p

25. A NEW APPROACH TO THE DETECTION OF SOLAR NEUTRINOS VIA INVERSE BETA DECAY F. Reines and R. M. Woods, Jr. 14 p (See N65-26787 16-29)

N65-26776 Chicago Univ., Ill.

MAGNETIC CLOUD CHAMBER SYSTEM TO STUDY INTERACTIONS UP TO 10^{12} eV

R. W. Thompson *In* Case Inst. of Tech. Proc. of Conf. on the Interaction between Cosmic Rays and High Energy Phys. [1964] 41 p refs (See N65-26775 16-29)

The facility for the study of high energy physics consists mainly of the target chamber, magnetic cloud chamber, proton chamber, and ionization calorimeter. The target thickness for which the maximum number of high energy interactions are obtained where the primary nucleon, the target nucleon, and all secondaries produced in the interaction escape without further interaction in the target is discussed. The magnetic Wilson cloud chamber of dimensions 1.2 × 1.2 × 0.3 meters situated in a magnetic field of 7000 G, the photon chamber, and the ionization calorimeter are considered. The proposed experimental program consisting of secondary interactions in light nuclei, the search for new long-lived hyperons and mesons, isobaric states of short lifetimes, neutral intermediate bosons, massive fundamental triplets, fireball investigation, and the measurements of cross sections of high energy nucleons and pions as a function of energy is reviewed. E.E.B.

N65-26777 Washington Univ., Seattle

COSMIC RAY MUON INTERACTIONS AT 5-50 GeV

Seth Neddermeyer *In* Case Inst. of Tech. Proc. of Conf. on the Interaction between Cosmic Rays and High Energy Phys. [1964] 6 p (See N65-26775 16-29)

Cloud chamber studies of the interactions of cosmic ray muons with electrons and nuclei are discussed. The work was done at muon energies from 5 to 50 GeV and with electron energies at a maximum of about 20 GeV. The observations muons in hard collisions with electrons. The experimental data suggests a new process in which a positive muon and an electron disappear; however, this possibility is still open to serious question. E.E.B.

N65-26778 Case Inst. of Tech., Cleveland, Ohio.

NEUTRINO AND MUON MEASUREMENTS 10 000 FT. UNDERGROUND

F. Reines *In its* Proc. of Conf. on the Interaction between Cosmic Rays and High Energy Phys. [1964] 5 p (See N65-26775 16-29)

An experiment to examine the interaction of high energy neutrinos produced in the atmosphere by high energy cosmic rays is described. In order to minimize the contribution from ordinary penetrating muons, the experiment will be conducted 10 500 feet underground in a South African gold mine. It is noteworthy that the atmospheric cosmic ray neutrinos are of higher energy than will be available for many years with electronuclear machines. The experiment may have astrophysical implications as well as direct relevance to the structure of the weak interaction. The equipment for the experiment is described. E.E.B

N65-26779 Utah Univ., Salt Lake City.

PROPOSED 800 m^3 DETECTOR FOR MUONS AND NEUTRINOS

Jack Keuffel *In* Case Inst. of Tech. Proc. of Conf. on the Interaction between Cosmic Rays and High Energy Phys. [1964] 12 p (See N65-26775 16-29)

The spark counter, an overgrown Geiger counter, 10 meters long and 15 cm in diameter, is made of 14 gage steel pipe with a wire down the middle. This counter and the directional Cerenkov counter, which are to instrument an experiment underground at 2000 ft in a mine near Park City, Utah to study cosmic ray neutrinos are described. During the experiment, the information collected will be digitized and recorded on magnetic tape directly. Two primary types of neutrino events may be observed with the experimental apparatus. One of these is a neutrino interacting inside the detector, a non-ionizing ray which traverses many nuclear paths, and then decays to a muon. The angular distribution and the distribution of the origins of these events will be studied. Also, the muons created in the long column of earth below the detector by a neutrino coming from below the horizon may be detected. If a boson decays primarily into pionic modes, there is also a possibility that it may be detected by the apparatus. E.E.B.

N65-26780 Tata Inst. of Fundamental Research, Bombay (India).

COSMIC RAY FLUXES AND POSSIBLE EXPERIMENTS

Yash Pal *In* Case Inst. of Tech. Proc. of Conf. on the Interaction between Cosmic Rays and High Energy Phys. [1964] 12 p (See N65-26775 16-29)

The composition of cosmic rays and the possible areas of experimentation are discussed. Nucleon, pion, muon, kaon, and neutrino fluxes are considered. Also, experimentation at mountain level and in the atmosphere is described. For a mountain experiment, it is noted that the fluxes of protons, neutrons, pions, and muons are comparable. Consequently, sophisticated equipment must be used to separate all primary particles. However, some components are easily separated by a large primary magnet and a total absorption caliometer. Neutral particles giving a large pulse in the calorimeter are neutron primaries; positive and negative particles giving no pulse in the calorimeter are positive and negative muons; and negative particles giving a large pulse in the calorimeter are negative pions. To separate protons and positive pions, some velocity measuring device must be added. The strong interactions of negative pions of hundreds of GeV can be studied with very little ambiguity. Nucleon isobaric states and nucleon–nucleon collisions are also considered. E.E.B.

N65-26781 California Univ., Berkeley.

PROPOSED BALLOON BORNE SYSTEM FOR INTERACTIONS ABOVE 10^{11} eV

Luis W. Alvarez and W. E. Humphrey *In* Case Inst. of Tech. Proc. of Conf. on the Interaction between Cosmic Rays and High Energy Phys. [1964] 10 p (See N65-26775 16-29)

The advanced technologies to be used in balloon experiments of cosmic radiation; superconductors, the wide-gap spark chamber, and nuclear emulsions combined with narrow-gap spark

chambers, are discussed. Also, the balloon experimentation is described for the beam defining section and the interaction detector section. The beam defining section consists of two parts. The first is a bag ten meters long, filled with butane. The object of this bag is to act as a part of the trigger mechanism for all of the electronics. The bag serves as a gas Cerenkov counter. The second part of this beam section is a momentum analysis apparatus consisting of a superconducting magnet and special emulsion plates. Experimentation will consider looking for high mass bound states which could possibly decay with pions in a backward direction. Also, secondaries should be observed in order to investigate the backward cone. E.E.B

N65-26782 Columbia Univ., New York.
EXPERIMENT TO DETECT BASIC TRIPLETS
M. Schwartz *In* Case Inst. of Tech. Proc. of Conf. on the Interaction between Cosmic Rays and High Energy Phys. [1964] 4 p (See N65-26775 16-29)

The question of the existence of basic triplets is discussed. A scheme based on two sets of triplets, one a set of baryons and the other a set of bosons, is considered. Mass and stability of these triplets is of some importance. If the splitting interaction is to be small, so that the first order perturbation theory applies, the binding energies should be large on the same scale. Hence, these triplets should have masses at least several times the masses of known particles. Although there is no a priori argument which can be made on the stability of the triplets, none of the known interactions will make these triplets decay into ordinary particles. Experimentation is proposed for sea level with careful timing techniques to search for these triplets. If there is no success at sea level, the experiment will be conducted by aircraft at high altitude. The experimental set-up is shown by schematic. E.E.B.

N65-26783 Michigan Univ., Ann Arbor.
PROPOSED SYSTEM TO STUDY INTERACTIONS AT 300 GeV
L. Jones *In* Case Inst. of Tech. Proc. of Conf. on the Interaction between Cosmic Rays and High Energy Phys. [1964] 7 p (See N65-26775 16-29)

The extent to which a cosmic ray experiment could explore, in a quantitative manner, the physics of strong interactions at about 300 GeV is discussed. The basic elements of such an experiment surrounds a liquid hydrogen target 1 meter thick by 2 x 5 meters in the horizontal. Large magnets are placed above and below the target, and spark chambers are used to analyze particles entering and leaving the magnetic field. An ionization calorimeter is located below the system, and the entire experiment is located on a 14 000 foot mountain. Basic to the design of such an experiment is the excellent spatial resolution available with a spark chamber. The resolution of the large-gap spark chambers are such that transverse momentum in collisons could possibly be determined to within 20 to 30 MeV/c. E.E.B.

N65-26784 Massachusetts Inst. of Tech., Cambridge.
γ-RAY INDUCED SHOWERS
George Clark *In* Case Inst. of Tech. Proc. of Conf. on the Interaction between Cosmic Rays and High Energy Phys. [1964] 11 p (See N65-26775 16-29)

The possibility of detecting the cosmic gamma rays near 10^{14} eV which arise from neutral muons produced in collision between cosmic rays and interstellar matter, and the apparatus built on Mt. Chacaltaya near La Paz, Bolivia are discussed. An ordinary air shower, initiated by a proton, has about 1% of penetrating particles. An electromagnetic shower is expected to have only about 0.01% penetrating particles generated by photonuclear interactions. It was decided to build a penetrating particle detector in the midst of an air shower detector, and to measure the muon density in individual showers with sufficient accuracy to identify pure electromagnetic showers. Results of the experiments are considered. Also, the energy spectrum of the ordinary primaries in the range from 10^{14} eV to 10^{16} eV was measured. It was found that the logarithmic slope of the integral spectrum from 10^{14} to 10^{15} eV was -2.1. At lower energies the slope was -1.7, while at higher energies, the slope was -1.6. Thus, there exists a peculiar anomaly in the primary energy spectrum around 10^{15} eV. E.E.B.

N65-26785 Case Inst. of Tech., Cleveland, Ohio. Dept. of Physics.
A SEARCH FOR INTERACTIONS PRODUCED BY COSMIC RAY NEUTRINOS
F. Reines, T. L. Jenkins, M. F. Crouch, and J. P. F. Sellschop (Witwatersrand Univ., Johannesburg) *In its* Proc. of Conf. on the Interaction between Cosmic Rays and High Energy Phys. [1964] 5 p refs Presented at Jaipur Conf. on Cosmic Rays, Jaipur, India, Dec. 1963 Sponsored by AEC (See N65-26775 16-29)

A large-scale underground experiment to detect neutrino-induced interactions is described. The individual detectors are slabs of a mineral oil based scintillator of very high optical clarity of 3.5 m^2 area each. A relativistic particle traversing the shortest dimension of this detector will deposit at least 20 MeV which is well above the energy of natural radioactive decays. The light is collected by four 5-inch photomultipliers. The full array will comprise 84 detectors aggregating 300 m^2. It is estimated that the signal will be 10 counts/year. The background from cosmic ray muons will be small compared to this rate. E.E.B.

N65-26786 California Univ., Berkeley. Space Sciences Lab.
PROPOSAL FOR HIGH ALTITUDE PARTICLE PHYSICS EXPERIMENT
Luis W. Alvarez and W. E. Humphrey *In* Case Inst. of Tech. Proc. of Conf. on the Interaction between Cosmic Rays and High Energy Phys. [1964] 46 p refs (See N65-26775 16-29)

The feasibility of precise high-energy experiments in the energy range from 100 to 1000 BeV and beyond in the upper atmosphere is considered. Except for emulsions, the techniques of measurement are quite conventional. The emulsion measurements would differ in that somewhat specialized equipment would be required. The measurements would be done as the last step in the analysis of events when the particle orbit and the need for the emulsion measurement was established from a preliminary analysis of the other information. The Cerenkow trigger, spark chamber–emulsion techniques, superconducting magnets, and the liquid hydrogen target are discussed in the design of the experiment. Also, the developmental and operational support, the balloon, telemetry, optics, and data analysis are included. E.E.B.

N65-26787 Case Inst. of Tech., Cleveland, Ohio. Dept. of Physics.
A NEW APPROACH TO THE DETECTION OF SOLAR NEUTRINOS VIA INVERSE BETA DECAY
F. Reines and R. M. Woods, Jr. *In its* Proc. of Conf. on the Interaction between Cosmic Rays and High Energy Phys. [1964] 14 p Sponsored by AEC (See N65-26775 16-29)

A method of detecting solar neutrinos by inverse beta decay is outlined. The reactions under consideration are

$$B^{11} + \nu_e = C^{11} + e^-$$
$$Li^7 + \nu_e = Be^7 + e^-$$

The reaction rate due to solar neutrinos in units of events per ton year for normal B and Li as a function of the lower limit chosen for the energy of the product electron are shown. Information is given which can be combined with statistical considerations to relate the mass of detector required to associate

the result with the direction of the sun. The backgrounds in the detector arrangement which arise from cosmic rays, neutrons, and gamma rays are discussed. A schematic of the detector system is included. E.E.B.

N65-26800# Joint Publications Research Service, Washington, D. C.
SOLAR MAGNETIC FIELDS AND SOLAR RADIO EMISSION BURSTS
16 Jun. 1965 37 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 42, no. 2, Mar.–Apr. 1965 p 217–232, 244–252
(JPRS-30649; TT-65-31277) CFSTI: $2.00

CONTENTS:

1. ON THE NATURE OF SOLAR MAGNETIC FIELDS (THE FINE STRUCTURE OF THE FIELD) A. B. Severnyy p 1–22 refs (See N65-26801 16-29)

2. ON THE ORIGIN OF SOLAR RADIO EMISSION BURSTS IN THE METER RANGE V. V. Zheleznyakov p 23–34 (See N65-26802 16-29)

N65-26801 Joint Publications Research Service, Washington, D. C.
ON THE NATURE OF SOLAR MAGNETIC FIELDS (THE FINE STRUCTURE OF THE FIELD)
A. B. Severnyy *In its* Solar Magnetic Fields and Solar Radio Emission Bursts 16 Jun. 1965 p 1–22 refs (See N65-26800 16-29) CFSTI: $2.00

Observational data on the fine structure of strong solar magnetic fields are discussed which are based on high resolution recordings. Study of the general solar magnetic field revealed the absence of a coherent and uniform polar field. The fine structure and spotty nature of the general magnetic field, and the inadequacy of its presentation by means of a dipole field, the disappearance of the resultant field at the south pole of the sun, and various other observations, are contrary to present concepts of the nature of magnetism of the sun. J.M.D.

N65-26802 Joint Publications Research Service, Washington, D. C.
ON THE ORIGIN OF SOLAR RADIO EMISSION BURSTS IN THE METER RANGE
V. V. Zheleznyakov *In its* Solar Magnetic Fields and Solar Radio Emission Bursts 16 Jun. 1965 p 23–34 refs (See N65-26800 16-29) CFSTI: $2.00

We discuss the problem of the origin of certain components of radio emission characteristic for the meter range: type I and type II bursts and reverse-drift pairs associated with type III emissions. The peculiarities of reverse-drift pairs are naturally explained if these phenomena are the result of combination scattering of excited plasma waves in these same plasma waves after their reflection from a local heterogeneity in the corona. In the interpretation of type II bursts, the characteristic "splitting" of the harmonic bands is associated with the Doppler effect in the transformation of plasma waves, excited into radio emission at the front of the shock wave. In conclusion we will consider certain methods of generating type I bursts. Author

N65-26893* Litton Systems, Inc., Minneapolis, Minn.
SOLAR-WIND BOMBARDMENT OF A SURFACE IN SPACE
G. K. Wehner *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 345–349 refs (See N65-26855 16-33) GPO: HC: $3.75 CFSTI: MF $2.75
(Contract NASw-751) CSCL 20H

The solar wind is described and its effects on surfaces are reviewed. Experimental results are given for materials subjected to simulated solar-wind bombardment. Among the effects discussed are sputtering-type erosion, chemical reaction with paint vehicles and reduction of oxide pigments, and production of lunar-surface optical characteristics in a basalt powder. Author

N65-27085# Massachusetts Inst. of Tech., Cambridge.
THE REACTION OF ATMOPSHERIC OZONE TO SUDDEN SOLAR DISTURBANCE Final Report, Mar. 1964–Feb. 1965
Hurd C. Willett and John T. Prohaska Apr. 1965 34 p refs
(Contract AF 19(628)-3854)
(AFCRL-65-201; AD-615489)

It is shown that previous evidence of a high cyclical correlation between total atmospheric ozone and relative sunspot number and between total atmospheric ozone and the mean latitude of the total area of sunspots cannot be explained by the seasonal, geographical, and chronological nonhomogeneity of the total ozone data. It was also shown that the relationship of ozone to sunspot latitude is not continuous, but that the ozone stimulating effect of sunspots apparently is cut off rather sharply when the mean latitude of sunspots moves poleward to about 12°. Also, Rasool found evidence of a rather sharp cutoff of the ozone stimulating effect of sunspots when the earth lies outside of a sunspot cone of about 15° radius. E.E.B.

N65-27131 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE SUN'S X-RAY EMISSION. IV: MEASUREMENT OF THE RADIATION FLUX IN THE SPECTRAL REGION 2–18 A
I. P. Tindo and A. I. Shurygin *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 135–143 refs (See N65-27125 16-13)

We present the results of measurements of the solar x-radiation flux made in the region of the spectrum from 2 to 18 A during vertical launchings of geophysical rockets to an altitude of about 500 km. The colar temperature of the emission in this region of the spectrum was determined; the results of the measurements are comparable to calculated values. Author

N65-27137 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BIOLOGICAL EFFECT OF COSMIC RADIATION IN THE EVENT THAT SOLAR FLARES OCCUR ON THE EARTH TO MOON ROUTE IN MODEL EXPERIMENTS
V. S. Morozov, V. V. Antipov, B. I. Davydov, N. N. Dobrov, P. P. Saksomov et al *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 241–250 refs (See N65-27125 16-13)

The necessity and possibility in principle of evaluating the biological effects of ionizing radiation under the conditions of a simulated radiation situation during a flight to the moon, with consideration of the appearance of chromospheric flares, are examined. The paper cites the results of preliminary experiments in simulating a brief solar flare under laboratory conditions. Author

N65-27140 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DYNAMICS OF THE GEOMAGNETIC TRAP AND THE ORIGIN OF THE RADIATION BELTS AROUND THE EARTH
V. D. Pletnev, G. A. Skuridin, V. P. Shalimov, and I. N. Shvachunov *In its* Cosmic Res., Vol. 3, No. 2, 1965 20 May 1965 p 265–274 refs (See N65-27125 16-13)

An attempt is made to examine the origin of the radiation belts about the earth as one of the aspects of the dynamics of the geomagnetic trap. Further development and validation of concepts regarding the mechanism of penetration of charged particles into the magnetosphere from solar wind and the trapping of these particles by the geomagnetic field, associated with great perturbations of the geomagnetic field is attempted. N.E.A.

N65-27175# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 1, NO. 6
[1965] 83 p refs
(AD-615879)

CONTENTS:

1. TRENDS IN THE DEVELOPMENT OF MODERN RADIOELECTRONICS p 1–8 ref (See N65-27176 16-07)
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3. SOVIET RESEARCH ON THE EFFECT OF HIGH PRESSURES ON SUPERCONDUCTIVITY D. Vvendensky p 18–22 refs (See N65-27177 16-09)
4. PROPAGATION OF THE ELF-VLF COMPONENTS OF LIGHTNING DISCHARGES S. G. Hibben p 23–29 refs (See N65-27178 16-29)
5. A RADIO METHOD FOR STUDYING IONOSPHERIC PARAMETERS A. Iwanovsky p 30–38 refs (See N65-27179 16-29)
6. SCIENCE & TECHNOLOGY NOTES p 39–69 refs

N65-27178 Library of Congress, Washington, D. C. Aerospace Technology Div.
PROPAGATION OF THE ELF-VLF COMPONENTS OF LIGHTNING DISCHARGES
Stuart G. Hibben *In its* Foreign Sci. Bull. Jun. 1965 p 23–29 refs (See N65-27175 16-29)

ELF and VLF signals generated by atmospherics have been recorded for several years in the USSR. A review of recent experimental findings is given, including amplitude and phase velocity spectra of lightning discharges registered at distances up to 6000 km. Where compared to data of U.S. workers, mean amplitude spectra show good agreement. From near and far range recordings, the coefficient of groundwave transmission is found for ELF-VLF frequencies. Author

N65-27179 Library of Congress, Washington, D. C. Aerospace Technology Div.
A RADIO METHOD FOR STUDYING IONOSPHERIC PARAMETERS
Arsen Iwanovsky *In its* Foreign Sci. Bull. Jun. 1965 p 30–38 refs (See N65-25175 16-29)

The measurement of ionospheric parameters, primarily electron concentration, by using the Doppler frequency shift of coherent radiowaves radiated from a satellite-borne transmitter was initially discussed in theory by Ya. L. Al'pert in 1958. Since then a series of articles has been published which is devoted to the consecutive development and refinement of this method, which was tested in experiments conducted by means of the Kosmos 1, Kosmos 2, Kosmos 11, and Elektron 1 satellites. Although not fully conclusive, the first findings are believed by the Soviet authors to be of considerable interest in obtaining a better understanding of ionospheric structure and processes. Author

N65-27226 Joint Publications Research Service, Washington, D. C.
ON THE THEORY OF THE RADIO EMISSION OF VENUS
A. S. Kuz'min *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 1–15 refs (See N65-27225 16-34) CFSTI: $6.00

We will give the analytical ratios connecting the brightness temperature of the radio emission of a planet surrounded by an absorbent atmosphere with the physical parameters of its surface and atmosphere. For particular cases of the absorption by the entire thickness of the atmosphere and absorption in homogeneous and parabolic layers, numerical solutions have been obtained. The latter are used for an interpretation of the results of radioastronomical measurements of Venus. Author

N65-27246 Joint Publications Research Service, Washington, D. C.
DETERMINATION OF THE DECLINATION OF CERTAIN EXTRA-GALACTIC RADIO SOURCES WITH THE LARGE PULKOVO RADIOTELESCOPE
V. Ya. Gol'nev, G. G. Novozhilova, and Yu. N. Pariyskiy *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 239–243 refs (See N65-27255 16-34) CFSTI: $6.00

Results of measurements of the declination of a number of discrete sources of radio emissions of metagalactic origin at the 6.4 cm wavelength, using observations made in the eastern azimuth, the meridian, and the western azimuth of the Pulkovo radiotelescope, are reported. It is shown that observations of declinations with the radiotelescope are as accurate as existing measurements even when there are small deviations of the azimuth of observation from the meridian. S.C.W.

N65-27247 Joint Publications Research Service, Washington, D. C.
SOME RESULTS OF MEASUREMENTS OF THE ATTENUATION OF COSMIC RADIO EMISSIONS IN THE IONOSPHERE
Yu. S. Korobkov *In its* Izv. VUZov: Radiophys., Vol. VIII, No. 1, 1965 24 Jun. 1965 p 244–247 refs (See N65-27225 16-34) CFSTI: $6.00

In the present article are the preliminary results of investigations of the transmission of cosmic radio emissions at frequencies of 5.7–6.3 Mc through the ionosphere, made at Gorkiy (Zimenka) in 1961–1964. The cosmic radio emissions at frequencies of 5.7–6.3 Mc were received on a horizontal broadside array, the main lobe of the directional pattern of which was turned to the zenith and had dimensions of 25° × 35° on the half-power points. The signal was fed from the antenna by a four-wire feeder to the input of the receiver, which had a band of 1 kc and a special arrangement for noise limitation. Author

N65-27346*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A COMPUTER PROGRAM TO CALCULATE ARTIFICIAL RADIATION BELT DECAY FACTORS
E. G. Stassinopoulos Washington, NASA, Jul. 1965 15 p refs
(NASA-TN-D-2874) CFSTI: HC $1.00/MF $0.50 CSCL 18D

A significant loss of Starfish electrons has occurred since their injection into the upper atmosphere on July 2, 1962. It is assumed that this artificial radiation-belt population decreases exponentially with time, thus, the remaining particle intensity may be adequately approximated by a decay factor of the form,

$$\exp\left(-\frac{\Delta t}{\tau}\right). \quad (1)$$

where τ is the mean lifetime of electrons with energies greater than 1.2 Mev and Δt is the specified time difference

$(t_2 - t_1)$. If the flux at time t_2 is then related to that of time t_1 by this decay factor, the expression,

$$\Phi(t_2) = \Phi(t_1) \exp\left[\frac{4(t_2 - t_1)}{(t_2 + t_1)}\right] \quad (2)$$

is obtained which may be used readily in a computer calculation. Author

N65-27386*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
COOLING OF NEUTRON STARS
Sachiko Tsuruta (Smithsonian Astrophys. Obs.) and A. G. W. Cameron [1965] 16 p refs
(NASA-TM-X-56594) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Calculations of the cooling of neutron stars are presented to illuminate the question of whether neutron stars might cool too rapidly to be observable as celestial X-ray emitters. In order to calculate representative cooling curves for neutron star models, three models were chosen: one was of low mass at the low density base of the principal peak, one was halfway up the peak, and the other was near the top of the peak. To these models were fitted hot atmospheres of iron and magnesium corresponding to a series of surface temperatures. The cooling curves are shown as a function of age. It is seen that the rate of cooling has a significant dependence on the mass of the star. The low mass stars cool quite rapidly, but the medium and heavy mass stars still have temperatures exceeding 2×10^{8}° K for times of the order of 10^4 or 10^5 years. Hence it is concluded that thermal emission of X-rays from neutron star surfaces must be regarded as candidates for identification with some of the X-ray sources which have been found in the sky. J.M.D.

N65-27386*# California Univ., San Diego.
TRAPPED PROTONS OF THE INNER RADIATION BELT
F. Walker Fillius (Ph.D. Thesis—State Univ. of Iowa) Jun. 1965 106 p refs
(Contracts NAS5-1683; NASr-116; Grant NsG-538)

Satellite Relay I has performed a thorough mapping of the energy spectrum and spatial distribution of protons in the inner zone. New intensity maps are presented in this paper for six energy ranges between 1.1 and 63 MeV as of January 1, 1963. With these six distributions and previously published intensities in two more ranges one can construct accurate energy spectra at arbitrarily selected locations throughout most of the inner zone. In any energy range the maximum intensity is found at the equator, and varies along a line of force near the equator as the third or fourth power of 1/B. There are fewer high energy than low energy protons, and they are found closer to the earth. Neutron albedo sources, both cosmic ray and solar proton sources, are weaker than required by as much as three orders of magnitude at 1 MeV. Adiabatic breakdown theories are in disagreement with the spatial dependence of the energy spectrum and cannot be controlling factors. Injection and diffusion of solar wind particles is a possible source, but more theoretical work is needed to clarify the expected results. Author

N65-27390*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N. Y.
EXTRA GALACTIC RADIO SOURCES
Wolfgang Priester and Johan Rosenberg Greenbelt, Md., NASA. Goddard Space Flight Center [1964] 132 p refs
(NASA-TM-X-56586) CFSTI: HC $4.00/MF $1.00 CSCL 20H

Observational results on radio galaxies and quasi-stellar radio sources (quasars) are reported. A simplified case of radiative transfer applicable to most radio astronomical problems is discussed. An expression for thermal radio spectra from ionized gas-clouds is derived. The radiation pattern of an accelerated electron is described, and the relation between the synchrotron spectrum of cosmic ray electrons and their energy distribution is shown. Descriptions of various sources of strong radio emission—the D galaxies, DE type galaxies, dumbbell galaxies, and N galaxies—are given. Several of the more closely studied radio galaxies are discussed. The optical features of quasars are listed, and hypotheses concerning formation of quasars, the phenomenon of intense radio luminosity, and the use of the redshift as a cosmological distance indicator, are discussed. J.M.D.

N65-27406# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
ANTARCTIC RESEARCH AND DATA ANALYSIS. TIME STRUCTURE OF GROUND LEVEL AND SATELLITE COSMIC RAY INCREASES
Sidney M. Bennett 15 May 1964 86 p refs
(Contract NSF C-255)
(RAD-TR-64-12)

The morphology of solar-related terrestrial cosmic ray increases has been studied using neutron-monitor, satellite, and riometer data. Data from numerous events were compared with the power law intensity decay

$$I(P > P_o) = I_o(P > P_o)\, t^{-m}$$

with t taken as zero at the "flash phase" of the solar flare. Results for five ground-level increases are mean m = 2.08, $s^2 = 0.01$, and for all eight events studied, mean m = 1.97, $s^2 = 0.043$. It is concluded that a power law decay with m = 2.0 is representative of the decay phase of moderate- to high-energy solar cosmic ray events. Two diffusion theories and a uniform magnetic field theory for propagation of solar particles in interplanetary space are discussed. The power law decay with exponent m = 2.0 corresponds to the theory which requires essentially uniform magnetic field strength along the path. It is suggested that the magnetic fields which guide solar cosmic rays arise in the solar "centers of activity" and not in the individual sunspots. Reanalysis of the delay time versus flare heliographic longitude supports the results of Obayashi and Hakura who found that a definite East-West asymmetry exists. We find that the delay time decreases markedly (and rather suddenly) when the flare region crosses the central meridian. Author

N65-27438 Joint Publications Research Service, Washington, D. C.
WHY MUST GEOMAGNETIC MEASUREMENTS BE MADE IN YEARS OF MINIMUM SOLAR ACTIVITY AND GEOMAGNETIC INTERFERENCE
In its Transl. on Communist China's Sci. and Technol., No. 189 22 Jun. 1965 p 21 Transl. into ENGLISH from K'o-hsueh Hsiao-pao (Peiping), 7 Feb. 1965 p 4 (See N65-27436 16-04) 16-04) CFSTI: $2.00

In view of the influence of sun spots, solar flares, and other activity on the accuracy of geomagnetic measurements made in years of intense solar activity, the initiation of an overall geomagnetic survey of the earth's magnetic field during years of minimum solar activity and geomagnetic interference is proposed. S.C.W.

N65-27475 Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE FORMATION OF SPECTRUM LINES

17 May 1965 468 p refs Proc. 2d Harvard-Smithsonian Conf. on Stellar Atmospheres, Cambridge, Mass., 20–22 Jan. 1965
(SAO Special Rept.-174)

Conference papers on the theory of line formation are presented. For individual titles, see N65-27476–N65-27504.

N65-27476 Hawaii Inst. of Geophysics, Honolulu.
SURVEY OF THE PROBLEM
J. T. Jefferies *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 1–10 refs (See N65-27475 16-30)

The problem of deducing the properties of the atmosphere from observations of the strength and shape of one or more spectral lines is outlined. In presenting a synthetic approach to the problem, the formation of spectral lines is considered, first under the assumption of the absence of background continuum radiation and then with allowance for it. The possibility of developing an analytical approach, based on inferential logic, is also considered. J.M.D.

N65-27480 University Coll., London (England). Dept. of Physics.
DIELECTRONIC RECOMBINATION
Alan Burgess *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 47–59 refs (See N65-27475 16-30)

Some analytical results on the recombination of $Ca^+ + e$ are reviewed in connection with the questions of the emission spectrum due to the process, and the possible effect of the increased density in the chromosphere. Expressions are given for the two processes which result in dielectric recombination; the recombination rate for one process is obtained from ordinary excitation cross section data through use of Correspondance Principle arguments, while the rate for the second is given by an Einstein coefficient. It was found that values of the total dielectronic recombination coefficient may exceed the corresponding radiative recombination coefficients by large factors, removing the discrepancy between coronal temperatures deduced from ionization balance calculations and from observed Doppler line broadening. It is shown that dielectronic recombination may be of importance even at high densities. J.M.D.

N65-27481 Technische Hochschule Hannover (West Germany). Institut für Theoretische Physik.
THE PLASMA MICROFIELD
K. Hunger, R. W. Larenz, and K. Wilke *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 61–69 refs Submitted for Publication (See N65-27475 16-30)

Numerical experiments on the lines of path integrations of stars in clusters have been performed to obtain the distribution of the electric microfield in a plasma. The resulting field differs from the Holtsmark field in the sense of higher mean field strengths when the number of plasma particles exceeds 1000. Author

N65-27482 Joint Inst. for Lab. Astrophysics, Boulder, Colo.
COMPUTATION OF THE LINE SOURCE FUNCTION—A REVIEW OF THE PHYSICAL PROBLEM
R. N. Thomas *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 71–99 (See N65-27475 16-30)

An approach to the study of arbitrary isolated gaseous ensembles is presented. Two aspects of the methodology problem are identified: definition of the state of an ensemble, and inference of the state by spectroscopic diagnostics alone. In the method described for determining radiative transfer solutions, the a priori assumption of local thermodynamic equilibrium is not made. Instead, a wholly microscopic approach is adopted for considering in detail all microscopic reactions populating energy states and for computation of the distribution functions for occupation numbers for each situation. J.M.D.

N65-27483 Smithsonian Astrophysical Observatory, Cambridge, Mass.
SOLUTIONS OF THE TWO-LEVEL LINE TRANSFER PROBLEM WITH COMPLETE REDISTRIBUTION
E. H. Avrett *In its* Formation of Spectrum Lines 17 May 1965 p 101–141 refs (See N65-27475 16-30)

Given two functions denoted by $\epsilon(\tau)$ and $B(\tau)$, the line absorption coefficient ϕ_ν, the ratio r of continuous to line absorption, and the continuum source function, then, assuming complete redistribution, it is possible to compute the line source function $S(\tau)$, and the theoretical intensity profile I_ν. Using a set of calculated results, we illustrate the way in which $S(\tau)$ and I_ν are influenced by $\epsilon(\tau)$, $B(\tau)$, ϕ_ν, and r. Author

N65-27484 University Coll., London (England). Dept. of Physics.
GENERAL NONCOHERENT SCATTERING
D. G. Hummer *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 143–148 refs (See N65-27475 16-30)

The existing numerical solutions of the transfer equation which do not make the assumption of a frequency-independent source function are reviewed. Author

N65-27485 Smithsonian Astrophysical Observatory, Cambridge, Mass.
A NEW DIFFERENTIAL EQUATION APPROACH TO TRANSFER PROBLEMS
George B. Rybicki *In its* Formation of Spectrum Lines 17 May 1965 p 149–163 refs (See N65-27475 16-30)

A new formulation of transfer problems is proposed. It uses the generalized Riccati transformation to convert two-point differential equations of transfer into equivalent sets of one-point systems, which are numerically stable. As an example the method is applied to the transfer problem of a two-level atom with continuum and complete redistribution in the line. The relationship of the method to the invariance techniques and to the methods of Fox and Feautrier is discussed. Author

N65-27486 Heidelberg Univ. (West Germany). Dept. of Theoretical Astrophysics.
A DIFFERENTIAL EQUATION FOR THE SOLUTION OF THE NON-LTE LINE TRANSFER PROBLEM
Erika Böhm-Vitense *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 165–175 ref (See N65-27475 16-30)

In a two-level atom the ratio of the occupation numbers N_2/N_1 is determined by

$$\int_{-\infty}^{+\infty} \kappa_{\nu 0} J_\nu d\nu = \bar{J},$$

taken over the line corresponding to the transition $1 \leftrightarrow 2$. Starting from the transfer equation and making use of the equations of statistical equilibrium a second-order differential equation is derived for $\bar{J}$. The procedure is extended to a multilevel atom. Author

N65-27487 Hawaii Inst. of Geophysics, Honolulu.
MULTILEVEL PROBLEMS
J. T. Jefferies *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 177–186 refs (See N65-27475 16-30)

The influence of interlocking on the relative values of line source functions is discussed. A criterion is established as to whether two lines will be effectively uncoupled, and an estimate obtained for the optical depth below which two lines of a common multiplet will share a common depth variation. A suggestion is given for a reformulation of the transfer equation to include the influence of interlocking in a more fundamental way. Author

N65-27488 Harvard Coll. Observatory, Cambridge, Mass.
RADIATIVE TRANSFER IN LINES FOR MEDIA IN STATISTICAL EQUILIBRIUM
Wolfgang Kalkofen *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 187–213 refs (See N65-27475 16-30)

The line transfer problem is discussed for a two-level atom and extended to an N-level atom. For N = 2 the source function is obtained, and non-linear and linear integro-differential equations are derived expressing the transfer problem subject to the condition of statistical equilibrium. From the differential equation the corresponding integral equations for the line source function are determined, and the integral kernels are discussed for the case of depth-dependent absorption profiles. The line components of the source function are derived for an N-level atom. The corresponding coupled integral equations for the resonance line components of the source function are discussed for the limit of low temperatures, and a method of solution is outlined. An analytic solution is obtained for the case of constant coefficients and integral kernels which are single exponential functions. Author

N65-27489 University Coll., London (England). Dept. of Physics.
CALCULATIONS OF COLLISIONAL–RADIATIVE DECAY
M. J. Seaton *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 215–219 refs (See N65-27475 16-30)

A brief bibliography is given on calculations of steady state equations for collisional–radiative decay, in the case where electron collisions dominate, and in the case where atomic collisions dominate. An unsuccessful attempt to obtain an iterative solution of the line transfer problem for a ten-level atom is described. J.M.D.

N65-27490 Indiana Univ., Bloomington. Dept. of Astronomy.
ON THE COUPLED LINE-TRANSFER PROBLEM FOR HYDROGEN
Hollis R. Johnson and Daniel A. Klinglesmith *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 221–248 refs (See N65-27475 16-30)

A standard non-LTE problem is proposed for testing and comparison of various methods for solving coupled line-transfer equations. The problem is to calculate the departures from LTE for a model atom of 3 bound levels and 1 free level in an atmosphere of constant temperature and density. A complete solution to the problem is formulated. Numerical results are presented for the case in which the radiation fields in the subordinate line and all continua are Planckian, but the radiative-transfer equations are solved for the two resonance lines. This case is discussed in detail, and final values of several parameters are printed for comparison with other work. Author

N65-27491 Harvard Coll. Observatory, Cambridge, Mass.
SOLUTION OF THE LINE AND CONTINUUM TRANSFER PROBLEM FOR A THREE-LEVEL ATOM
W. Kalkofen and E. H. Avrett *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 249–274 (See N65-27475 16-30)

The non-LTE radiative transfer problem is solved for an atomic model consisting of three discrete levels and a continuum. The physical parameters are those for hydrogen. The kinetic temperature and particle density through the atmosphere are assumed constant. The line source functions are assumed to be independent of frequency. The radiation emerging from the atmosphere is found to differ in several respects from the radiation emerging from the corresponding LTE atmosphere. The emergent continuous flux is depressed relative to the LTE flux and shows discontinuities at the Lyman and Balmer absorption edges. The line radiation exhibits absorption and emission features, and the intensity in the extreme line wings is smaller than the LTE intensity. The iterative procedure that we use is slowly convergent, and may introduce uncertainties into the results. Author

N65-27492 Paris Observatory, Meudon (France).
SOLUTION OF THE TRANSFER PROBLEM
Y. Cuny *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 275–295 refs (See N65-27475 16-30)

The radiative transfer problem for a bound-bound or a bound-free transition is solved numerically. The method is applied to a three-level hydrogen atom with continuum in a pure hydrogen atmosphere with constant temperature and density. The effect of the photoionization terms on the line source functions is discussed. Author

N65-27493 Sacramento Peak Observatory, Sunspot, N. Mex
INFERENCE OF THE LINE SOURCE FUNCTION FOR THE SODIUM D LINES
G. W. Curtis *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 301–332 refs (See N65-27475 16-30)

Waddell's sodium D lines limb darkening data are submitted to a new analysis suggested by Jefferies. This analysis is based on the following assumptions: (i) For the sodium D lines, the line source function S_l is frequency independent and (ii) at a given physical depth is a common parameter for D_1 and D_2; (iii) the shape of the absorption coefficient is common to both lines and (iv) the continuous source function S_c is frequency independent over the spectral range here considered. One main objective of this analysis is to obtain as a function of depth the values of S_l and S_c when no *a priori* assumption is made concerning the existence or nonexistence of LTE. This analysis indicates that with the possible exception of the outermost layers the sodium D lines are found in LTE. Author

N65-27494 Indiana Univ., Bloomington. Dept. of Astronomy.
SODIUM EQUILIBIRUM AND THE Na I D LINES
Hollis R. Johnson *In* Smithsonian Astrophis. Obs. Formation of Spectrum Lines 17 May 1965 p 333–345 refs (See N54-27475 16-33)

The departures from LTE of Na I have been obtained theoretically for an atom of 5 bound levels and a continuum by solving the steady state and radiative transfer equations in a self-consistent fashion by a simple iterative method for a model solar atmosphere. We find the source function is equal to the Planck function below $\tau_0 = .001$. Higher in the atmosphere, significant departures are obtained. The departures are displayed and discussed. Transition rates contributing to the source function of the sodium D lines are studied in order to show that the source function is collisionally dominated.

No rise in the source function at the region of the temperature inversion in the low chromosphere is obtained, although a broad plateau exists there. Author

N65-27495 Joint Inst. for Lab. Astrophysics, Boulder, Colo.
THE PROFILES OF THE SODIUM D LINES
D. Mugglestone *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 347–353 refs (See N65-27475 16-30)

In the wings of the D lines LTE theory reproduces the observed line profiles, to within $\Delta\lambda \approx 0.15$ of the line center, for an abundance value in close agreement with that obtained from analysis of the medium-strong lines. In the core region, $\Delta\lambda$ 0.15, non-LTE theory is essential for reproduction of the observed profiles. The source function is found to be collisionally controlled and, for pure noncoherent scattering, the the theoretically derived collisional parameter reproduces the observed profile with a good accuracy. Author

N65-27496 Sacramento Peak Observatory, Sunspot, N. Mex.
AN ANALYSIS OF SOLAR BALMER LINE PROFILES
Oran R. White *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 355–379 refs (See N65-27475 16-30)

A review of White's earlier work in the Balmer line limb-darkening problem is given in conjunction with a discussion of the basic approach to line profile analysis. An empirical temperature model of the solar chromosphere is presented to describe the run of kinetic and excitation temperatures for the Hα, Hβ, Hγ, Paschen α, Paschen β, and Brackett α transitions in neutral hydrogen. A comparison of the empirical model with theory indicates that the self-consistent treatment of the statistical equilibrium equations and radiative transfer equations for a multilevel hydrogen atom may resolve current discrpancies between theory and observation. The appearance of the Hα line at the extreme limb is described in terms of the current line formation theory. Author

N65-27497 Mount Wilson Observatory, Pasadena, Calif.
STELLAR CHROMOSPHERES AND Ca II H AND K EMISSION
Olin C. Wilson *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 381–387 Prepared jointly with Palomar Obs. Summary and discussion (See N65-27475 16-30)

Investigations of the intensities and widths of the Ca II resonance lines H and K in the spectra of G, K, and M stars are summarized. The relationship between the widths of the steep outer edges of the H-K emissions and the absolute visual magnitude was calibrated from high dispersion spectra of the sun and of four yellow giants in the Hyades moving cluster. Strong evidence for a correlation between H-K emission intensity and the evolutionary age of the star was found. The H-K emission, found in virtually all G, K, and M giants and supergiants, is also present with variable intensity among main sequence stars. Moving up along the main sequence, the point of H-K emission disappearance was discovered near the point below which there is only slow stellar rotation. J.M.D.

N65-27498 Harvard Coll. Observatory, Cambridge, Mass.
OBSERVATIONAL REQUIREMENTS FOR A THEORY OF FORMATION OF H AND K LINES
Leo Goldberg *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 389–396 (See N65-27475 16-30)

Data relevant to the question of the formation of the H and K lines are presented. The K line is shown in a photograph made with the slit of the spectrograph placed along a radius across the solar limb. The double reversal, plotted in relation to the whole profile of the K line, was recorded on a photoelectric tracing. A series of highly magnified photoelectric profiles, made at cos θ values 1.0 and 0.2, are shown. Double reversals observed in the Mg+ lines are also shown. Requirements of a theory to explain these observations are discussed. J.M.D.

N65-27499 Hawaii Inst. of Geophysics, Honolulu.
THE CALCIUM H AND K LINES IN SOLAR PLAGES
J. B. Zirker *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 397–404 refs (See N65-27475 16-30)

Profiles of the Ca II H, K, and infrared triplet lines observed in a plage are discussed. The H and K profiles are proportional throughout the core. Author

N65-27500 Smithsonian Astrophysical Observatory, Cambridge, Mass.
DIELECTRONIC RECOMBINATION AND THE SOLAR H AND K LINES
Robert W. Noyes *In its* Formation of Spectrum Lines 17 May 1965 p 405–410 refs (See N65-27475 16-30)

Quantitative investigations of the role of dielectronic recombination in the H and K lines have been carried out by numerically solving for the K line source function for a two-level atom with complete redistribution. It is found that: a) The direct contribution of the new process to the emission reversal must be considerably less important than originally suggested, because the large electron density required to support the process causes the line source function to rise to the Planckian in the region of formation of the emission reversal, thus dominating over the dielectronic emission. b) The indirect contribution of the process to the emission, via locally increasing the effective ϵ in the transfer equation and thus locally raising the K line source function, cannot be effective if there is complete redistribution in the line. Author

N65-27501 High Altitude Observatory, Boulder, Colo.
TOTAL FLUXES IN STRONG EMISSION LINES
R. Grant Athay *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 411–423 refs (See N65-27475 16-30)

A new method is derived for computing the contribution to the total intensities of emission lines formed out of thermodynamic equilibrium in the outer regions of stellar atmospheres. The method is much simpler and more easily applied than than existing methods. The simplicity and ease of application are achieved by sacrificing information regarding the shape of the line and, consequently, by limiting the amount of detailed information that can be derived concerning the atmosphere producing the radiation. The method is very useful, nevertheless. Author

N65-27502 Royal Greenwich Observatory, Herstmonceux (England).
DEDUCTIONS AS TO ACCURACY OF LTE FROM EXCITATION TEMPERATURE MEASUREMENTS, AND A COMMENT ON THE ABUNDANCE OF "TRACE ELEMENTS"
B. E. J. Pagel *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 425–435 refs (See N65-27475 16-30)

The argument between the predicted and observed relative strengths of solar absorption lines from levels having different excitation potentials, as normally expressed by the statement of an "excitation temperature," imposes strict limits on the possible departures from LTE; in particular, the source functions of most neutral metal lines of the iron group in the visual region

must be close to their LTE values. Some possible departures from LTE are shown by the differential excitation temperatures (relative to the sun) of some K giants. The role of the ultraviolet radiation field in controlling the ionization of some trace elements, like beryllium, is stressed. Author

N65-27503 College de France, Paris.
MICROMOTIONS, MACROMOTIONS, AND NON-LTE EFFECTS
Jean-Claude Pecker and Francois Roddier *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 437–451 refs Prepared jointly with Centre Natl. de La Rech. Sci., Paris (See N65-27475 16-30)

In the spectral regions around λ 4227 (Ca), λ 4607 (Sr), and λ 5536 (Ba), micromotions, macromotions, and non-LTE (local thermodynamic equilibrium) effects were studied. The analysis stresses the importance of determining simultaneously the velocity fields (both micro and macro) and the non-LTE effects, and shoes that the LTE assumption is not a valid priori hypothesis. J.M.D.

N65-27504 Paris Observatory, Meudon (France).
NON-LTE EFFECTS ON ABUNDANCE DETERMINATION
Roger Cayrel *In* Smithsonian Astrophys. Obs. Formation of Spectrum Lines 17 May 1965 p 453–461 refs (See N65-27475 16-30)

This paper expresses some general ideas concerning the possible ways in which non-LTE effects may affect abundance determination. It is suggested that this rough analysis is possibly an improvement over the detailed analysis as far as departures from LTE are concerned. Author

N65-27687*# National Aeronautics and Space Administration. Washington, D. C.
MONITORING THE LEVEL OF COSMIC RADIATION DURING THE FLIGHTS OF VOSTOK-3, VOSTOK-4, VOSTOK-5 AND VOSTOK-6 [KONTROL' ZA UROVNEM KOSMICHESKOY RADIATSII VO VREMYA POLETA KOSMICHESKIKH KORABLEY VOSTOK-3, VOSTOK-4, VOSTOK-5 I VOSTOK-6]
I. A. Savenko, N. F. Pisarenko, P. I. Shavrin, and V. Ye. Nesterov Jun. 1965 9 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 2, 1965, p 40–43 Presented at 5th Intern. Symp. on Space Res. (COSPAR), Florence, 1964
(NASA-TT-F-9386) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The effects of solar activity and magnetic storm, and artificial factors (atomic explosions) are examined. Differences in radiation dosages and composition are compared in many flights with varying parameters, as are readings from various on-board apparatus. Tissue doses of several cosmonauts under varying conditions are compared. Author

N65-27824*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CHARGE RATIO OF COSMIC-RAY ELECTRONS
Frank C. Jones 21 Jun. 1965 11 p refs Submitted for Publication
(NASA-TM-X-55232; X-641-65-250) CFSTI: HC $1.00/MF $0.50 CSCL 20H

In considering the process $p + p \rightarrow 2N + n\pi$; $\pi^{\pm} \rightarrow \pi^{\pm} + \nu$; $\pi^{\pm} \rightarrow e^{\pm} + 2\nu$ as a source of cosmic-ray electrons, it has been assumed that at high energies the ratio $N(e^{+})/N(e^{-}) \approx 1$. This assumption is based on the concept that charge conservation limits the excess of positively charged secondaries arising from any collision to at most, two. The high multiplicity of secondaries arising from many GeV collisions then tends to erase this excess leading to approximate equality of the number of positively and negatively charged electrons. Considerations are presented which point out that this assumption is probably not true and that at high energies the ratio will be considerably larger than one. E.E.B.

N65-27825*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIFFUSION OF PROTONS IN THE OUTER RADIATION BELT
M. P. Nakada and G. D. Mead Jun. 1965 49 p refs Submitted for Publication
(NASA-TM-X-55234; X-640-65-273) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The diffusion of protons in the outer radiation belt due to violation of the third adiabatic invariant has been examined. The particular mechanism studied is one where variations in the solar-wind intensity produce magnetic disturbances causing motion of particles between L-shells. A Fokker-Planck diffusion equation is used with terms describing Coulomb energy degradation and charge-exchange losses with the ambient atmosphere. A source near the magnetopause is assumed. The diffusion constant is numerically evaluated by an analysis of observed frequencies of sudden impulses and commencements. The equation is solved to obtain radial and energy distributions. A comparison of the results with the measured proton fluxes of *Davis, Hoffman, and Williamson* indicates that a diffusion process of this general nature seems to be responsible for the observed outer-belt protons. For the parameters selected, the magnetic disturbances studied may not be sufficient to produce the required diffusion rate. The effects of possible changes in parameters are discussed. Author

N65-27834# Minnesota Univ., Minneapolis. Cchool of Physics and Astronomy.
ELECTRONS, HYDROGEN AND HELIUM NUCLEI OBSERVED IN THE PRIMARY COSMIC RADIATION DURING 1963
P. S. Freier and C. J. Waddington May 1965 42 p refs
(Contract Nonr-710(60))
(CR-74; AD-616297)

Singly and doubly charged particles in the cosmic radiation were observed during a ballpon flight made over Fort Churchill on the 28th July 1963. These particles were detected in nuclear emulsions mounted in a mechanical device which imposed unique temporal resolution between those entering during the balloon ascent and those entering while the balloon floated at ceiling altitude. The integral intensity at the top of the atmosphere of protons having $E > 74$ MeV was determined to be 2440 ±160 protons/m^2 ster. sec. while that of helium nuclei having $E > 62$ MeV per nucleon was 272 ±13 nuclei/m^2 ster. sec. The differential energy spectra of the protons and helium nuclei have been studied over the energy ranges of 74 MeV $\leq E \leq$ 4 BeV and 62 MeV per nucleon $\leq E \leq$ 1.67 BeV per nucleon respectively. Because of the unprecedented energy range covered in the proton study, it has been possible to compare these particles over a far greater spread of overlapping rigidities than has hitherto been possible. Small numbers of electrons were also observed with results which are in reasonable agreement with those previously reported by other workeers. The problem of correcting for secondary electrons appears unresolved, but if ignored, a total intensity of 63 ±26 electrons/m^2 ster. sec. with 130 MeV $\leq E \leq$ 5 BeV was observed under 2 g/cm^2 of air. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-26668 Deutsches Hydrographisches Institut, Hamburg (West Germany).
ON THE ORGANIZATION OF ASTRONOMICAL TIME DETERMINATIONS BY MEANS OF AN AUTOMATIC PZT [ZUR ORGANISATION ASTRONOMISCHER ZEITBESTIMMUNGEN AM AUTOMATISIERTEN PHOTOGRAPHISCHEN ZENIT-FERNROHR (PZT)
Heinz Enslin *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 179–187 ref In GERMAN; FRENCH and ENGLISH summaries (See N65-26657 16-14)

With a PZT operating automatically, it is possible to distribute the observations (2 or 3 star groups per night) over any portion of the night. Taking into account the special conditions prevailing at Hamburg, the paper deals with the question of how to distribute the groups over the night for a maximum efficiency in view of the improvement of the star catalogue. Although it could be guessed that the morning and evening hours are specially suited for this purpose, this is true only when no new unknown is thereby introduced (diurnal effect). Author

N65-26669 Observatoire de Paris (France).
THE VARIATIONS OF THE ROTATIONAL SPEED OF THE EARTH [LA VARIATION DE LA ROTATION DE LA TERRE]
Anna Stoyko *In* Soc. Suisse de Chronometrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 189–194 refs In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

Three different types of variations are known: secular, irregular and seasonal. The secular and irregular variations have been discovered and studied by means of observations of the moon and the planets, while the seasonal variations were discovered by comparisons of the time of quartz clocks with astronomical time determinations. At present, the variations of the rotational speed of the earth are determinated by means of atomic frequency standards. The definitive time as computed by the Bureau International de l'Heure and plotted against an uniform atomic time, gives a very detailed representation of the variations of the rotational speed of the earth. A critical review of the rotation of the earth is given, making use of lunar observations and atomic frequency standards as well. Correlations are found between the rotation of the earth and different geophysical and solar phenomena. Author

N65-26670 National Bureau of Standards, Boulder, Colo.
SPACETIME COORDINATE SYSTEMS
G. E. Hudson *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 197–221 refs (See N65-26657 16-14)

Examples of two operational definitions for spacetime networks associated with the surface of the spinning earth serve to make definite some of the requirements, and show the importance and use of the general Doppler effect. For space navigational purposes, the Doppler effect becomes a prime tool. Its uses and the relative effects of gravitational fields, medium refraction and dispersion, and instrument uncertainty are to be discussed with some numerical examples. The point of view we have adopted here stems from, but is not limited to, a consideration of general relativistic effects and uses much of the formalism of relativity theory. It suggests moreover, a new general approach to time synchronization, space communication, and navigation problems, which is reminiscent of several concepts introduced by various authors. One of these is the elementary 4/3-earth notion of Schelling, Burrows, and Ferrell. A related one is the use of "homologue" space to eliminate major refraction effects in a medium. Still a third is Fock's concept of harmonic coordinates. These approaches will be explained in elaborating the conceptual basis for this paper. Author

N65-26673 Observatoire Cantonal, Neuchâtel (Switzerland).
THE FLUCTUATIONS OF THE ATMOSPHERIC REFRACTION AND THEIR EFFECT ON THE MEASUREMENTS WITH A PHOTOGRAPHIC ZENITH TUBE (PZT) [INFLUENCE DES VARIATIONS DE LA REFRACTION ATMOSPHERIQUE SUR LES MESURES A LA LUNETTE ZENITHALE PHOTOGRAPHIQUE (PZT)]
W. Schuler *In* Soc. Suisse de Chronométrie Intern. Conf. on Chronometry, Vol. 1 [1964] p 241–252 In FRENCH; ENGLISH and GERMAN summaries (See N65-26657 16-14)

Slow fluctuations, of about the same duration as the recording time of the PZT (2 min), of the atmospheric refraction were detected by the following setup: stars trailing through the field of view of a fixed refractor (aperture 25 cm, same as PZT) were recorded photographically under different meteorological and seeing conditions. The lateral deviations of the star tracks were subsequently measured photoelectrically with the measuring microscope. The results show that fluctuations of amplitude up to 1" and duration of the order of the PZT exposure time can occur. Such fluctuations not only result in poor image quality, as fast fluctuations do, but also affect the average coordinate of the image. Author

N65-26902* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ALTERATION OF SURFACE OPTICAL PROPERTIES BY HIGH-SPEED MICRON-SIZE PARTICLES
Michael J. Mirtich and Herman Mark *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 473–481 refs (See N65-26855-33) GPO: HC $3.75; CFSTI: MF $2.75

Micron-size particles were accelerated by aerodynamic drag to gas speeds in a 3-inch shock tube to simulate some aspects of micrometeoroid erosion. A streak-camera technique was used to make velocity measurements in the gas-heated, radiating cloud of particles. Good agreement was obtained between measured and theoretically predicted velocities. Integrated density measurements were made by collecting the particles on disk collectors. Aluminum and aluminum-coated disks were placed in the shock tube and exposed to bombardment by a known number of particles with known velocity, size, and composition. Author

N65-26924*# Smithsonian Astrophysical Observatory, Cambridge, Mas.. Data Div.
SN LLITE ORBITAL DATA
Beatrice Miller 24 Mar. 1965 73 p *Its* Special Rept.-169 (Grant NsG-87-60)
(NASA-CR-63511) CFSTI: HC $3.00/MF $0.75 CSCL 02

Satellite orbital elements derived from several days observations are tabulated. Tabulated values are given for argument of perigee, right ascension of the ascending node, inclination, eccentricity, and mean anomaly. Also listed are the mean motion, orbital acceleration, and semimajor axis or the geocentric distance of perigee. The effects of the short-period

perturbations due to the earth's oblateness were eliminated. Observations were made on Explorer 1, 8, and 9, Vanguard 2 and 3, Telstar 1 and 2, Anna 1B, and Relay 1. R.N.A.

N65-26958# Joint Publications Research Service, Washington, D. C.
RANDOM ERRORS IN MEASURING THE ALTITUDES OF CELESTIAL BODIES AT SEA
A. Rakhovetskiy 21 Jun. 1965 8 p Transl. into ENGLISH from Morsk. Flot (Moscow), no. 1, Jan. 1965 p 20–21 (JPRS-30714; TT-65-31301)

Star altitude measurements were made from positions at sea for determining the causes of random errors in measurements of this kind. The effect of random errors is estimated as the mean square error ϵ_h. The data, together with similar past data from various observers, is given in tabular form, and examination of the table leads to several conclusions. The accuracy of star altitude measurements made during good horizon visibility with the sun's depression in the sky at 3–5° is the same as the mean accuracy of star altitude measurements which are usually made with the sun's depression at 6–11°. The mean square errors for measurements made for both conditions is similar, and is just under one tenth of a minute. With hazy visibility conditions, the ϵ_h measurement is two minutes or greater, making the accuracy lower. Thus the accuracy of star altitude measurements depends upon the quality of the horizon and the hydrometeorological elements more than upon the amount of illumination. The results are supported by results of data processed from night observations of stars during lunar illumination. L.S.

N65-26982*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
SEVERAL TRAJECTORY OPTIMIZATION TECHNIQUES. PART II: APPLICATION
H. Gardner Moyer and Gordon Pinkham [1965] 16 p refs (Contracts NAS8-1549; AF 49(638)-1207) (NASA-CR-63645; GRD-119-II; AFOSR-65-0603; AD-615155) CSCL 22C

This paper discusses the application of the three optimization methods — steepest descent, second variation, and generalized Newton-Raphson — to the problem of minimum time, low thrust, circle-to-circle transfer. Details of computational techniques that have proved successful in practice are presented. The number of iteration cycles and the time used by are given for each method. Author

N65-27031# Joint Publications Research Service, Washington, D. C.
INTERPLANETARY FLIGHT
V. Seleznev 29 Jun. 1965 11 p Trans. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 5, May 1965 p 84–87 (JPRS-30847; TT-65-31368) CFSTI: $1.00

A narrative approach to the problems involved in an interplanetary flight is presented. The take-off and tasks involved during flight and approach of the planet are discussed. M.W.R.

N65-27055*# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
[INVESTIGATION OF RADAR ECHOES FROM THE MOON PLANETS, USING METHODS AND DATA FROM EARTH RADAR-RETURN STUDIES] Semiannual Status Report, 1 Nov. 1964–30 Apr. 1965
Ahmed Erteza, James A. Doran, and Donald H. Lenhert May 1965 10 p ref (Grant NsG-129-61) (NASA-CR-63537; EE-124) CFSTI: HC $1.00/MF $0.50 CSCL 03A

This work was aimed at extending the concept of differential reflectivity to give better estimates of the surface properties (both roughness and electromagnetic) of a reflecting body. The major areas of extension are monostatic reflection from a statistically rough sphere, bistatic reflection from a deterministic surface, and reformulation of a Kirchoff-Huygens approach into a form appropriate for use with the concept of differential reflectivity. Also presented is a short discussion of areas of future work. Author

N65-27057*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37–32, VOLUME VI FOR THE PERIOD JANUARY 1, 1965 TO FEBRUARY 28, 1965. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
31 Mar. 1965 59 p refs (Contract NAS7-100) (NASA-CR-63530; JPL-SPS-37-32, Vol. VI) CFSTI: HC $3.00/MF $0.50 CSCL 22A

This summary of JPL space exploration programs and related supporting research includes sections on the lunar and planetary-interplanetary programs, the Deep Space Network, and space instruments and their systems. A digest of the unclassified information relating to the Ranger, Surveyor, and Mariner projects is given. A review of the quality assurance and reliability efforts, and the environmental testing activities is presented. Parts reliability investigations include sections on qualification testing of crystal-can nonlatching relays, a failure-mode study of power wirewound resistors, and transistor X-ray inspection. M.W.R.

N65-27068# Joint Publications Research Service, Washington, D. C.
THE COSMONAUT STEPS OUT OF THE SPACESHIP
Ye. Sergeyev and V. Alekseyev 30 Jun. 1965 11 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 4, Apr. 1965, p 14–18 (JPRS-30865; TT-65-31384) CFSTI: $1.00

A permanent orbital station is proposed to serve as a medical laboratory to study the physiological, psychological, clinical, and morphological state of man under weightlessness. It is also to be used to train cosmonauts for future long-lasting interplanetary missions. The problems to be encountered in assembling such a space station are discussed. Problems of orientation, and control of movements outside the spacecraft are examined. In order for man to effectively operate in open space he must learn new methods of orientation, methods of body movement or retention while performing tasks under weightlessness, and the use of special tools and devices for accomplishing these goals. R.N.A.

N65-27156# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Radiophysics Lab.
THE RADIOPHYSICS LABORATORY, C. S. I. R. O., AUSTRALIA, 1963–1964
[1964] 132 p refs

Developments in the research fields of radio astronomy and cloud physics are presented. Included are discussions on a 210-ft radio telescope, an interferometer using the 210-ft telescope and a movable 60-ft telescope, lunar occultations, polarization and Faraday rotation, radio emissions from Jupiter, galactic radio sources, 21-cm hydrogen line studies, distant

galaxies, new interstellar lines in the radio spectrum, the radioheliograph, cloud physics, convective cloud studies, ice nucleus investigations, lunar influences, and rainmaking. R.N.A.

N65-27170# Manchester Univ., Macclesfield (England). Dept. of Astronomy.
FORMULAE AND AUXILIARY TABLES FOR THE REDUCTION OF LUNAR OBSERVATIONS [FORMELN UND HULSFSTAFELN ZUR REDUKTION VON MONDBEOBACHTUNGEN UND MONDPHOTOGRAPHIEEN]
Kasimir Graff Nov. 1964 91 p refs Transl. into ENGLISH of Veröffentl. Koniglichen Astronmischen Rechen-Inst. (Berlin), no. 14, 1901
(Contract AF 61(052)-524)
(AFCRL-65-328; AD-615367)

Formulae and Auxiliary Tables for the Reduction of Lunar Observations contains a most useful collection of formulae and other supporting material which are indispensable for accurate reduction of lunar observations for selenodetic purposes. The content of the report is covered in five chapters which are as follows: (1) Preliminary Calculations; (2) Effect of the Rotation and Revolution of the Moon upon the Position of its Axis and Equator Relative to the Earth; (3) Determination of Position on the Lunar Surface; (4) Illumination Ratios of the Moon; and (5) Determination of Selenographic Dimensions. N.E.A.

N65-27173# Federal Scientific Corp., New York.
EXPERIMENTAL VERIFICATION OF STAR IDENTIFICATION BY OPTICAL RADIATION ANALYSIS Technical Documentary Report, Jul. 1963–Jul. 1964
Wright-Patterson AFB, Ohio, AF Avionics Lab., Feb. 1965 108 p refs
(Contract AF 33(657)-11467)
(AL-TDR-64-251; AD-614238)

The purpose of this investigation is to experimentally verify prior theoretical conclusions that it is feasible for stars to be recognized from their radiation for use in the guidance and navigation of space vehicles. The experiments were performed at a terrestrial location with equipment capable of high precision measurements. The results indicate that within the atmosphere measurement accuracies are limited primarily by the atmosphere, but are still adequate for reliable stellar recognition. The precision of the measurements achieved are a factor of two better than for data generally published. Author

N65-27185# RAND Corp., Santa Monica, Calif.
ECLIPSE OBSERVATIONS FROM ORBITING SPACECRAFT
R. C. Moore and G. F. Schilling May 1965 46 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4557-PR; AD-615949)

The expected appearance of the earth and sun from within the earth's shadow-cone is derived for various distances from the earth's surface. Results suggest that unique information about the earth's upper atmosphere can be obtained from manned and unmanned spacecraft by utilizing well known eclipse techniques. It is shown that existing physical conditions permit the conduct of relevant experiments with simple instrumentation from most space missions within cislunar space. Author

N65-27208# Battelle Memorial Inst., Columbus, Ohio.
SURVEY OF INSTRUMENTATION AND INSTRUMENTAL TECHNIQUES FOR THE SCIENTIFIC EXPLORATION OF THE MOON
J. L. Mc Farling Huntsville, Ala., Redstone Sci. Information Center, 30 Apr. 1964 79 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-286; AD-462516)

This report reviews current development of instrumentation and instrumental techniques aimed at scientific and engineering measurements on the moon. It is intended to be both a reference source and to indicate instrument requirements. Various instruments built or under development for the measurement of many types of lunar properties are discussed. Instruments to measure engineering parameters as well as those for purely scientific measurements are included for both manned and unmanned missions. An attempt has been made to cover all the major categories of interest to lunar research. Instruments and techniques for performing the following types of measurements have been included. These are lunar topography; physical properties of lunar surface; lunar petrological analysis; lunar seismology; lunar magnetic, electric, and gravitational fields; lunar micrometeorite and radiation fields, and lunar atmosphere and ionosphere measurements. Author

N65-27221# Joint Publications Research Service, Washington, D. C.
SOME LESSONS LEARNED FROM FLIGHT OF THE VOSKHOD-2
M. D. Yemel'yanov 23 Jun. 1965 9 p Transl. into ENGLISH from Zdorov'ye (Moscow), no. 5, May 1965 p 5–6
(JPRS-30761; TT-65-31322) CFSTI: $1.00

The environment of space is discussed with particular reference to temperature, optical characteristics, ionizing radiation, and atmosphere. The problem of weightlessness is also considered. The space suit of the cosmonaut, as an independent life support system, is briefly described. Further, the experimental effort prior to space flights to insure the success of such missions in the various scientific areas is emphasized. E.E.B.

N65-27285# Smithsonian Astrophysical Observatory, Cambridge, Mass.
AN ANALYSIS OF THE ATMOSPHERIC TRAJECTORIES OF 413 PRECISELY REDUCED PHOTOGRAPHIC METEORS
Luigi G. Jacchia, Franco Verniani, and Robert E. Briggs 23 Apr. 1965 317 p refs
(SAO Special Rept.-175)

In this paper we present a statistical evaluation of the atmospheric trajectories of the 413 precision-reduced meteors, doubly photographed with the Super-Schmidt cameras in New Mexico, for which orbital data have been previously published and analyzed by Jacchia and Whipple. We have studied the dependence of heights, lengths, decelerations, and magnitudes on such basic parameters as velocity, angle of incidence, and mass, as well as on derived parameters such as the ablation coefficient and the fragmentation index; the latter are in turn related to the other geometric and physical characteristics, including the phenomena of wake and terminal blending. A comparison with classical meteor theory shows again and again that fragmentation is the most important factor in causing the wide discrepancies between theory and observation. Author

N65-27289# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
VELOCITY AND TIME REQUIREMENTS FOR ORBITAL TRANSFER AND RENDEZVOUS
Tom Jennings Forster and Lawrence Lee Gooch (M.S. Thesis) Aug. 1964 116 p refs
(GA/MECH-64-3; AD-610231)

This thesis presents a nomographical technique for determining the total velocity increment and time required to complete an orbital transfer between two elliptical orbits in the same gravitational sphere of influence. The general case of non-coaxial, inclined, elliptical orbits is considered. The

problem is simplified into a pseudo-coplanar problem by making the plane change at the line of nodes. The mathematical model used is based on unperturbed conic sections and instantaneous velocity impulses. The elements of the transfer ellipse are derived in terms of the orbital parameters of the initial and final orbits. The departure point, arrival point, and change in flight path angle at departure or arrival are the independent variables. This choice of independent variables is made to enable selection of the minimum energy transfer path and to enhance mission reliability. The solution to the problem is portrayed on a set of nomographs which provides answers of sufficient accuracy for the initial planning of a mission. Because the nomographs are designed to give answers in terms of non-dimensional ratios, the solutions are applicable in any gravitational sphere of influence. The report also includes investigations of timing control and velocity optimization. A time matching technique is presented for the selection of the transfer path necessary to rendezvous. A velocity optimization study is offered as a guideline in selecting the transfer path requiring the minimum total velocity increment.

Author

N65-27307# Toronto Univ. (Ontario). Inst. of Aerophysics.
THEORETICAL INVESTIGATIONS OF THE DYNAMICS OF BODIES ENTERING THE ATMOSPHERE Final Technical Report
B. Etkin Feb. 1963 8 p refs
(Grant AF-AFOSR-62-40)
(AFOSR-4553; AD-615120)

Research relating to a long-term project on flight dynamics is listed. A digital program for the IBM-7090 was developed to determine reentry calculations. The RCAF CF100 simulator is being adapted for simulating reentry flight paths. A theoretical framework for analyzing the rotational and relative motions of compound satellite systems is summarized.

M.W.R.

N65-27382*# Ohio State Univ., Columbus. Antenna Lab.
SEMIANNUAL REPORT FOR PERIOD 1 OCTOBER 1964–30 APRIL 1965
1 Jun. 1965 7 p ref
(Grant NSG-213-61)
(NASA-CR-63639) CFSTI: HC $1.00/MF $0.50 CSCL 03A

Studies concerned with the relations between the radar scattering properties of the moon and its surface features are summarized. Theoretical investigations were made on the correlation between two waves scattered from a rough surface resulting from two incident plane waves at different frequencies. Measurements of the amplitude correlation of two frequencies, $< |E_1^s| |E_2^s| >$, have shown that the average drops to one-half of its initial value at frequency separations of about 2 to 4 kc. A re-evaluation was made of the instrumentation and data reduction techniques used in a Doppler spectrum experiment. Programs have been written for computing the position of the moon, the overall Doppler frequency, and the Doppler spread due to libration of the moon. Experimental studies have also been concerned with instrumentation design for the various investigations underway and with measurement of the beamwidth of the moon.

M.W.R.

N65-27416# Massachusetts Inst. of Tech., Cambridge.
THE 1965 MINTA MARTIN LECTURE: ON FUTURE SCIENTIFIC AND MANNED SPACE FLIGHT PROJECTS
Abraham Hyatt [1965] 52 p refs Published in cooperation with AIAA

The past, present, and future of the space program are covered, and cost estimates of future projects are included. It is suggested that the cost of the national space program be rationalized as an investment in the future, since the program may eventually pay for itself many times over through new products, processes, industries, and knowledge. Phasing out the present manned spaceflights as they are completed, and expanding certain space science projects, as outlined could cut in half the annual cost of the overall program by the early 1970's. The Manned Orbiting Laboratory should be considered the most important and logical next manned space flight project. It is felt that too little is known at the present time about man's functioning, survivability, and usefulness in space to be concerned with distinctive space laboratory designs for military or nonmilitary use.

M.W.R.

N65-27459*# General Dynamics/Convair, San Diego, Calif.
SURVEYOR LAUNCH OPPORTUNITIES FOR MID-1965 THROUGH 1968
R. C. Stover, H. C. Cherin, and D. C. Swanson 7 May 1965 82 p refs
(Contract NAS3-3232)
(NASA-CR-54442; GD/C-BTD65-069) CFSTI: HC $3.00/MF $0.75 CSCL 22C

Periods during which Surveyor lunar flights can be performed are indicated in four tables, data for which were calculated by a computer program. Both one-burn (direct) and two-burn (parking orbit) ascent trajectories are detailed in these tables; for the one-burn ascents, the effects of removing the launch azimuth restrictions of 90 and 114 degrees are considered. The data, which are tabulated on a daily basis for the 3 1/2-year period, show the hours of sunlight or darkness remaining at the landing site from the landing time to the next passage of a lunar terminator. Ascent characteristics of the Atlas-Centaur (AC-15) configuration and basic ground mission rules were used to formulate models of the proposed Surveyor flights.

M.W.R.

N65-27516*# Stanford Univ., Calif. Radioscience Lab.
RADAR MEASUREMENTS OF THE TOTAL CISLUNAR ELECTRON CONTENT Technical Report No. 8
H. T. Howard, V. R. Eshleman, G. H. Barry, and R. B. Fenwick May 1965 22 p refs
(Grant NsG-377)
(NASA-CR-63656; SU-SEL-65-052) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Two lunar radars were used to perform the first measurements of the total integrated electron density between the earth and the moon. The measurements were accomplished by determining the difference in time delay between 25 and 50 Mc/s moon-reflected signals to an accuracy of 10 μsec. The experiment was made possible by the use of FM radar transmissions with time-bandwidth products of 10^5. Subtraction of ionospheric electron contents from the totals determined from the differential group delay measurements, suggests that there are two distinct regions beyond the ionosphere. Within the solar wind wake of the earth, in the quadrant opposite the sun, the average cislunar electron density beyond the ionosphere is approximately (300 ± 50) cm^{-3}. In the general direction of the sun, where most of the radar path is beyond the shock wave boundary, the average density is much lower, $(100 \pm^{70}_{150})$ cm^{-3}. Ionospheric and magnetospheric contents and experimental uncertainty are discussed. The initial results clearly show a marked effect which is interpreted here as an average electron density inside the shock front, in a magnetospheric wake extending at least as far as the lunar orbit, which exceeds the solar wind density by about 200 cm^{-3}.

Author

N65-27525# Smithsonian Astrophysical Observatory, Cambridge, Mass.
TRANSFER OF RADIATION IN STOCHASTIC MEDIA

Geoge B. Rybicki 4 Jun. 1965 188 p refs
(Grant NSF GP-2226)
(SAO Special Rept.-180)

Radiative transfer equations are derived for a medium with small stochastically defined opacity and energy fluctuations. These equations provide relations between the correlation functions connecting these fluctuations and the induced fluctuations in the radiation field. Also, the theory is shown to provide a description of the solar atmosphere, which has statistically defined inhomogeneities due to an underlying convection zone. A simple inhomogeneous solar model atmosphere is defined by giving the statistical distribution of energy sources in the atmosphere. It is also shown that a generalized limb-darkening law allows the observable intensity autocorrelation function to be used to find the depth dependence of the autocorrelation function of the source function. Further, a method of extending the results to model atmospheres with a depth-dependent opacity is given which uses the generalized Riccati transformation applied to transfer equations in differential form. E.E.B.

N65-27533# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
15 000 000 LUMEN OF ELECTRIC SOLAR LIGHT
Yu. Medvedev 9 Apr. 1965 16 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), No. 3, 1962 p 25–32
(FTD-TT-64-1081/1+2; AD-614762)

A three-phase 300-kW ballastless gas discharge lamp bulb, is described. Each 100-kW section of the bulb emits 5 million lumens, and all three-phases operating together yield 15 million lumens. The bulb emits as much light as would be generated by 25 thousand 5-watt incandescent lamps requiring 1250 kW. The artificial light emitted is very close in spectral composition to sunlight, yet promises to be a highly economical transformer of electricity into light. Since light yield is greater when the temperature of radiating body is higher, and the temperature of the bulb core is higher than on the surface of the sun, its extremely high efficiency of 50 lumens per watt is accounted for. Replacement of the bulb in lamps may allow for a sharp reduction in the consumption of non-ferrous and ferrous metals, cost of mounting, electric wire, and maintenance. L.S.

N65-27587# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTS IN TELEVISION PHOTOGRAPHY OF THE MOON IN THE 0.8-1.1 AND 0.8-2.3 μ RANGE
N. F. Kuprevich 30 Mar. 1965 17 p refs Transl. into ENGLISH from Izv. Astron. Observ. (Paulkovo), v. 23, no. 2, 1963 p 110–114
(FTD-TT-65-90/1+2; AD-614395)

The article describes the results of observing the surface of the moon in the spectral range of 0.8–2.3μ by means of a television system. Comparison is made between infrared photographs and those taken earlier by other authors in the visible range. It was discovered that with an increase in wavelength into the infrared region of the spectrum the photos exhibited an increase in contrast and revealed lunar surface details not detected on ordinary photographs. It is proposed that the increase in contrast and the appearance of new details in the lunar surface image may be explained by a decrease in luminescent radiation in the infrared rays. Author

N65-27641*# National Aeronautics and Space Administration. Washington, D. C.
ASTRONAUTICS AND AERONAUTICS, 1964-CHRONOLOGY ON SCIENCE, TECHNOLOGY, AND POLICY
Eugene M. Emme 1965 533 p refs
(NASA-SP-4005) GPO: HC $1.75; CFSTI: MF $2.50 CSCL 22A

A chronology on the seventh year of the Spage Age, prepared from open public sources, is presented, and is intended to provide a ready reference for current use and for future analysts and historians. Separate chronologies are listed as appendixes and cover satellites, space probes, manned space flights and major NASA launchings for 1964. Abbreviations of references are included. L.S.

N65-27643*# Analytical Mechanics Associates, Inc., Uniondale, N. Y.
PRECISION TRAJECTORIES FOR THRUSTING VEHICLES AND THE PROPAGATION OF THE ERROR COVARIANCE MATRIX THROUGH THRUST AND COAST Third Quarterly Report
S. Pines Feb. 1965 13 p ref
(Contract NAS9-2527)
(NASA-CR-65052) CFSTI: HC $1.00/MF $0.50 CSCL 03B

This report contains an Encke type method for a precise determination of the trajectories for thrusting vehicles. A closed form expression for the approximate trajectory is taken from the known solutions of the motion of a thrusting vehicle in a uniform gravitational field under the action of an inertially fixed thrusting vector of constant thrusting magnitude. The perturbation deviation from this known solution is integrated using conventional techniques. In addition, the report contains an approximate solution of the variational equations for the thrusting vehicle. A method is described for obtaining an approximate solution for the propagation of the covariance matrix of the errors in the position and velocity of the vehicle due to random Gaussian variations in the initial conditions of the state, in the magnitude and direction of the thrust, and the time of the onset and termination of the thrust. Author

N65-27663# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
LUMINESCENCE OF THE LUNAR SURFACE Mathematical Note No. 391
Zdenek Kopal Feb. 1965 41 p refs Submitted for Publication
(DI-82-0410)

Factors involved in the luminescent phenomena from the lunar surface are discussed. Three categories of incident radiation from the moon are considered: scattered sunlight which can be seen from the earth's surface, absorbed and re-emitted sunlight whose waves cannot penetrate the earth's atmosphere and cannot be seen from the ground, and other high energy uv and X-ray quanta and corpuscular radiation from the sun. It is postulated, and observations indicate support, that the recombination of atoms from the third category does not occur by a single transition process as in the other two categories, but by a cascade process giving rise to luminescent emission at longer wavelengths, which can penetrate the atmopshere of the earth and be observable on the ground. Solar influence, direct or indirect, on lunar brightness is cited, and the 11 year solar cycle is related to the luminar luminosity. Observational evidence indicates that the luminescence of the moon occurs and recurs in certain regions on its surface, suggesting strong localization of the luminophor of unknown chemical structure. L.S.

N65-27666 System Development Corp., Santa Monica, Calif.
A PROOF OF THE CONVERGENCE OF THE POINCARE-VON ZEIPEL PROCEDURE IN CELESTIAL MECHANICS
Richard Barrar 4 Jan. 1965 29 p refs
(SP-1926; AD-610694)

A proof of the convergence of the Poincaré-von Zeipel procedure in celestial mechanics is presented. Although this procedure, as originally developed by Poincaré, was believed to lead only to asymptotic series, it is shown that for a set of frequencies of density close to one, the procedure actually converges. Author

N65-27684*# National Aeronautics and Space Administration, Washington, D. C.
RECONSTITUTION OF RE-ENTRY INTO THE ATMOSPHERE OF A MISSILE, BASED ON DATA MEASURED IN FLIGHT [RECONSTITUTION DE LA RENTREE DANS L'ATMOSPHERE D'UN MISSILE A DARTIR DE MESURES EN VOL]
J. Bouttes Jun. 1963 18 p Transl. into ENGLISH from Paper Presented at ONERA Colloq. Intern. de Tech. e Calcul Anal. et Numerique en Aeron. Liege (France), 9–12 Sep. 1963
(NASA-TT-F-9382) CFSTI: HC $1.00/MF $0.50 CSCL 16B

A method for calculating the probable trajectory of a missile on re-entry, based on data recorded in flight (accelerometer readings, drag coefficient, specific heat ratios, static pressure, dynamic pressure, etc.) is described, with graphs of the telemetered data. The calculation is performed on a DC analog computer with recording of the data on a varyplotter, permitting a rapid estimate and computation of the probable trajectory. Author

N65-27779# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
AN INTERFEROMETER INVESTIGATION OF THE TWENTY-ONE CENTIMETER HYDROGEN LINE ABSORPTION
B. G. Clark 1965 47 p refs
(Contract Nonr-220(19))
(AD-462968)

The brightness distributions across five intense radio sources have been investigated in the hydrogen line absorption features have been resolved into Gaussian components. In some cases there has been found a variation of the absorption across the face of the source, which, with the kinematical distance to the cloud in question, allowed a typical length to be estimated, which in turn allows estimations of densities and masses. Densities range from a few atoms per cubic centimeter to 680 atoms per cubic centimeter. Masses range from a few solar masses up to perhaps a thousand solar masses in the cloud causing the deep line in Cas A. Three absorption spectra never before published and new upper limits for the absorption of apparently unabsorbed sources were set in six cases. The distribution law for central optical depths is approximately $e^{-\tau_0}$, and that a line of sight, on the average, intersects 4.1 clouds per kiloparsec in the galactic plane. Author

N65-27781# Joint Publications Research Service, Washington, D. C.
SOME PROBLEMS IN TIMING PHOTOGRAPHY IN DETERMINING THE COORDINATES OF AN ARTIFICIAL EARTH SATELLITE BY THE METHOD OF REFERENCE STARS
L. L. Voskresenskiy, V. S. Plotnikov, and F. Ye. Sobolev 9 Jul. 1965 15 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Geod. i Aerofotos. (Moscow), no. 1, Jan. 1965, p 81–90
(JPRS-30991; TT-65-31489) CFSTI: $1.00

A photogrammetric method of measuring the coordinates of an orbiting earth satellite is presented. In this method the satellite is photographed against a background of starry sky. A rotating shutter is used, producing in effect an instantaneous time-exposure. The time of exposure is recorded in the photograph. A method of determining time corrections, both for flat and spherical image fields, is explained. The means of estimating the accuracy in exposure time and coordinate measurements is given. Formulas to establish the tolerance limits for manufacture and assembly of the shutter are derived. The accuracy of the measurements, relative to the conditions of the satellite image and the condition of the image of the surrounding stars, can reach $\pm 3\mu$, which corresponds to a determination of the satellite angular coordinates with an accuracy of ± 1.5 to 2.0 seconds. J.M.D.

N65-27812*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
EXTRAGALACTIC RADIO SOURCES
Wolfgang Priester and Johan Rosenberg Washington, NASA, Jul. 1965 57 p refs
(NASA-TN-D-2888) CFSTI: HC $3.00/MF $0.50 CSCL 03B

This paper, based partly on lectures on radio astronomy given at the Columbia University Summer Institute in Space Physics in 1964, reports on the observations of radio galaxies and quasi-stellar radio sources (quasars). The basic physical processes responsible for continuous radio emission are studied. Author

N65-27859# New Mexico Univ., Albuquerque.
THE OBSERVATION AND COMPUTATION OF REENTRY TRAJECTORIES WITH THE AIRBORNE ASTROGRAPHIC CAMERA SYSTEM Technical Report, Jan. 1963–Sep. 1964
James D. Wray Kirtland AFB, N. Mex., AF Spec. Weapons Center, Apr. 1965 305 p refs
(Contract AF 29(601)-6284)
(AFSWC-TR-64-6; AD-465075)

A detailed theory is presented for computation of reentry trajectories. The theory is intended for application to an airborne range facility consisting of two aircraft. Such a facility is described, as are the fundamental principles of data acquisition by this system. The observational techniques developed for the system permit the recording of stars of photographic magnitude +6.5 with exposure times of 0.2 second. Techniques for rapid identification of comparison stars are presented. A modified 12-constant plate reduction theory is employed with excellent results (~ ±5 arc seconds) in airborne applications. A complete data-reduction flow diagram covering film processing and measurement to final data product is presented, as are the detailed FORTRAN computer programs developed for the reduction and analysis of all spatial reentry trajectory data gathered by the system. Author

N65-27897# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
MOTION OF THE MOON AND DYNAMICS OF THE EARTH–MOON SYSTEM Mathematical Note No. 402
Zdenek Kopal Mar. 1965 132 p refs
(DI-82-0425)

An account of the kinematic properties of the moon and of the dynamics of the earth–moon system are summarized for the technical reader. The basic facts of distance, size, and mass of the moon; the motion of the moon in space rotation of the moon—optical librations, motion of the moon about its center of gravity—physical librations; photometric consequences of the moon is motion—phases and eclipses; and dynamics of the earth–moon system are the major divisions of this treatise. E.E.B.

N65-27903# System Development Corp., Santa Monica, Calif.
EXISTENCE OF CONDITIONALLY PERIODIC ORBITS FOR THE MOTION OF A SATELLITE AROUND THE OBLATE EARTH
R. B. Barrar 18 Jan. 1965 27 p refs
(SP-1935/000/00; AD-610693)

The author's previous results on the convergence of the Poincaré-von Zeipel procedure in celestial mechanics are applied to the problem of the motion of a satellite around the oblate earth. The investigation concerns a potential that can vary both longitudinally and latitudinally, and also includes behavior near the critical angle. The existence of conditionally periodic orbits in all these cases is established. Author

N65-27955*# Geophysics Corp. of America, Bedford, Mass. Technology Div.
STUDY OF THE AVERAGE VERTICAL DISTRIBUTION OF TEMPERATURE IN THE MARTIAN ATMOSPHERE Final Report
George Ohring and Joseph F. Mariano Mar. 1965 81 p refs (Contract NAS9-2423)
(NASA-CR-65049; GCA-TR-65-3-N) CFSTI: HC $3.00/MF $0.75 CSCL 03B

Theoretical computations of the vertical distribution of temperature in the Martian atmosphere are performed with the use of a combined convective-radiative equilibrium model. The model assumes that the Martian troposphere is in convective equilibrium and the Martian stratosphere is in radiative equilibrium. The height of the tropopause is a by-product of the computations. Computations are performed for several physical models of the Martian atmosphere to allow evaluation of the effect of present uncertainties in such parameters as carbon dioxide content, surface pressure, tropospheric lapse-rate, surface temperature, water vapor content, and distribution of absorbing gas with height. On the basis of these calculations, a tentative model of the average vertical distribution of temperature profile is based upon computations with an assumed surface pressure of 25 mb, carbon dioxide amount of 55 m STP, water vapor amount of 10^{-3} prec. cm, adiabatic lapse-rate in the troposphere, and surface temperature of 230° K. It is characterized by a tropopause at a height of about 5 km and an upper stratosphere temperature of about 145° K above 45 km. Author

N65-27960*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MANNED SPACE FLIGHT NETWORK PERFORMANCE ANALYSIS FOR THE GT-2 MISSION
O. Womick, Jr. 14 May 1965 55 p
(NASA-TM-X-55227; X-552-65-204) CFSTI: HC $3.00/MF $0.50 CSCL 22A

The second Gemini mission (GT-2) was an unmanned suborbital flight of the Gemini spacecraft to validate the launch vehicle, spacecraft systems, and to obtain spacecraft performance data concerning reentry heating protection under maximum reentry conditions. Four telemetry links were monitored during the flight: two launch vehicles and two spacecraft links, CNV, GTK, and BDA recorded real-time data and remoted it to MCC for display to the flight controllers; RKV and CSQ displayed data to the on-board flight controllers; and MCC, GBI, ANT, and the four aircraft recorded telemetry for posttest analysis. Among the topics discussed are: (1) network support preparations, (2) system performance, (3) computing system performance, and (4) NASCOM performance. Among the findings it was suggested that further tests be conducted with the RKV prior to subsequent Gemini missions to insure an equipment operational readiness. Also, it was suggested that these tests include the antenna systems. R.W.H.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-27060*# Naval Ordnance Test Station, China Lake, Calif. Weapons Development Dept.
PENDULUM-TYPE NUTATION DAMPER USED IN THE NASA ATMOSPHERIC STRUCTURE SATELLITE, S-6
H. L. Newkirk Jun. 1965 81 p refs
(NASA Order S-4562-G)
(NASA-CR-63571; NAVWEPS-8525; NOTS-TP-3520) CFSTI, HC $3.00/MF $0.75 CSCL 22C

A reliable passive device was developed for quickly damping out nutational motion of the spin-stabilized NASA S-6 satellite (Explorer 17). A list of the Bureau of Naval Weapons drawings for it is given. The operating principles for this twin-pendulum damper were determined with the aid of a small table-top gyroscopic model. Final developmental testing was done with a full-scale dynamical simulator. Formulas for each of the three basic criteria are derived. These formulas are (1) for tuning the damper to the nutational disturbance, (2) for the selection of the viscous friction coefficient of the pendulum hinge, and (3) for the guarantee that the desired final balanced and stable configuration of damper and satellite will be obtained. Author

N65-27123# Lockheed-California Co., Burbank. Technical Information Center.
SPACE PROGRAMS, 1962–1975
E. E. Whitney Jun. 1965 37 p

Information containing current and planned future programs, has been prepared entirely from information available in the open literature. Organization of the material is by booster used for the launch, and in each case, designation, name, dimensions, costs, and launching date are given, if known. The schedule is updated quarterly. Author

N65-27362*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
TELEMETER DESIGN PARAMETERS FOR NIKE APACHES 14.171 GE–14.176 GE
J. C. Modlin and R. W. Conrad Apr 1965 46 p
(NASA-TMX-55222; X-671-65-169) CFSTI: HC $2.00/MF $0.50 CSCL 22B

This report covers the design philosophy and operational performance evaluation of the telemeter system for Nike Apache sounding rockets 14.171 GE through 14.176 GE. Data are included in Appendices A and B to allow the reader to make final measurements on components of each payload telemeter and notes for setting up and checking out the entire system. Design and performance evaluation for these telemeter systems were conducted by GSFC's Sounding Rocket Instrumentation Section personnel. Included are preliminary flight results indicating that these systems performed as predicted and that good experimental data is expected. Author

N65-27387*# Aeronutronic, Newport Beach, Calif. Research Lab.
LUNAR FACSIMILE CAPSULE PROGRAM Bimonthly Technical Progress Report No. 3, 23 Feb.–26 Apr. 1963
15 May 1963 67 p Prepared for JPL
(Contracts NAS7-100; JPL-LC-950462)
(NASA-CR-63608; U-2126) CFSTI: HC $3.00/MF $0.75 CSCL 22B

Final design reviews were held and drawings of the first prototype were released. Developmental and breadboard models of most subassemblies were fabricated and functional tests of these breadboards initiated. A summary for each task is tabulated showing the status of preliminary design and quality assurance, prototype top tube development, prototype azimuth drive and extension mechanism development, test structures, breadboard motor drive and signal electronics, breadboard

ground reproducer, prototype assembly and testing, breadboard porting mechanism, prototype transmitter, and systems integration. E.F.B.

N65-27472*# National Aeronautics and Space Administration, Washington, D. C.
MARINER IV PRE-ENCOUNTER PRESS CONFERENCE, JET PROPULSION LABORATORY 22 Jun. 1965 News Release
[1965] 78 p Available from Scientific and Technical Information Division

The National Aeronautics and Space Administration presents the minutes of a press conference at the Jet Propulsion Laboratory pertaining to the encounter of Mariner with the Mars vicinity. An outline of the Mariner IV flight background is given, together with the sequence of events that will lead the spacecraft to the back of the planet to the desired occultation position. G.G.

N65-27875*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1969 ORBITER TECHNICAL FEASIBILITY STUDY
P. K. Eckman 16 Nov. 1964 558 p refs
(Contract NAS7-100)
(NASA-CR-63748; EPD-250) CFSTI: HC $8.58/MF $2.75 CSCL 22B

A 90-day orbit of Mars is considered feasible in 1969 if the 30% floxed Atlas/Centaur performance estimates can be demonstrated. Major technological developments required deal with in-orbit control and operation of the spacecraft. Ground-based capability will be required; however, it is considered doubtful that observations can be made of the same small area of Mars at high resolution over many months. Northeast launches required for Type I trajectories are considered significantly advantageous in terms of short flight times, low communication distances, and in-orbit geometry. Type I trajectories, because they do not pass inside the Earth's orbit early in transit, reduce communications gray-out. An orbital period of 42 hr, with a periapsis altitude of 1500 km and an apoapsis altitude of 50 000 km, is expected to yield maximum in-orbit payload, reduce sun and canopus ocultation problems, and permit more time for command and control decisions. Details relating to the mission, the spacecraft and its subsystems, and environmental constraints are included. M.W.R.

N65-27878*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GODDARD PROJECTS SUMMARY: SATELLITES AND SOUNDING ROCKETS
1 Jan. 1965 45 p
(NASA-TM-X-56413) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The satellite and space probe projects of the flight center are summarized. Launch, orbit, and experimental data are given for each event. Also, the objectives of each launch are included. Further, a chart is presented to show the regions of space as viewed by different disciplines. E.E.B.

N65-27950*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
TO MARS: THE ODYSSEY OF MARINER IV
[1965] 38 p
(Contract NAS7-100)
(NASA-CR-63762; JPL-TM-33-229) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The purpose of the Mariner IV, a description of the spacecraft, a review of the in-flight events, and a discussion of the long-distance communication and scientific experiments for this project are presented. Also, a log of Mariner IV from lift-off to June 15, 1965 and the positions of the spacecraft at 10-day intervals starting December 1, 1964 until July 14, 1965 are tabulated. Further, orbit data are included. E.E.B.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-26923*# Florida Univ., Gainesville. Dept. of Engineering Science and Mechanics.
RESEARCH INVESTIGATIONS OF BULKHEAD CYLINDRICAL JUNCTIONS EXPOSED TO COMBINED LOAD, CRYOGENIC TEMPERATURE. PART III: THEORETICAL ANALYSIS OF THE THERMAL LOADS
Chi-Wen Lin, C. A. Sciammarella, and H. Wagner Aug. 1964 81 p refs
(Contract NAS8-5199)
(NASA-CR-63507) CFSTI: HC $3.00/MF $0.75 CSCL 13M

In the joint portion of the intertank of a missile, due to the varying thickness of each part of the shell, the low temperature fuel used in the tank and the comparative high temperature induced from the solar radiation may generate a highly polynomial distribution of the temperature at this region. The thermal stresses induced in this manner are important in considering the thin shell construction of the joint. The problem is solved under the assumption of uniform temperature distribution along spatial axis of the cylindrical shell and constant in the whole semi-elliptical bulkhead. The temperature gradient in the axial axis is accepted from an experimental result but with modifications. Solution of this problem following an investigation based on the membrane theory leads to the fact of the existence of geometrical compatibility. The edge affects induced on considering the continuity of displacements and bending moment give the satisfactory solution for the present analysis. Author

N65-26947# Forest Products Lab., Madison, Wis.
BUCKLING COEFFICIENTS FOR FLAT, RECTANGULAR SANDWICH PANELS WITH CORRUGATED CORES UNDER EDGEWISE COMPRESSION
Paul M. Jenkinson and Edward W. Kuenzi May 1965 19 p refs *Its* MIL-HDBK-23 Working Group, Item 58-2
(Contract AF 33(615)-65-5002; BuWeps Order 19-65-8005-Weps)
(FPL-25; AD-463425)

This report presents curves of coefficients and formulas for use in calculating the buckling of flat panels of sandwich construction with corrugated cores under edgewise compressive loads. The formulas apply to sandwich panels having: (1) one facing of orthotropic material, the other facing of an isotropic material; (2) both facings of orthotropic material; or (3) both facings of isotropic materials. Parameters are chosen so that facings may be of different thicknesses and so that facings can also be of different isotropic or orthotropic materials. Equations are presented for various edge conditions, simply supported

and clamped. Curves of buckling coefficients are presented and for simply supported sandwich panels with both facings either isotropic or orthotropic. Author

N65-26953# Brown Univ., Providence, R. I. Div. of Engineering.
AN ANALYSIS OF LONGITUDINAL ELASTIC–PLASTIC PULSE PROPAGATION Technical Report No. 41
R. J. Clifton and S. R. Bodner Mar. 1965 36 p refs
(Contracts Nonr-562(20); ARPA SD-86)
(Nonr-562(20)/41; AD-461443)

The one-dimensional rate independent theory of elastic-plastic wave propagation for smooth stress-strain curves concave toward the strain axis is applied to the problem of a long uniform bar loaded at one end by a pressure pulse of short duration. The essential features of the solution are obtained for the case of a semi-infinite bar and for the case of a finite bar whose other end is stress free by using the method of characteristics in the t-x plane. The general shape of boundaries in the t-x plane which separate regions governed by the dynamic elastic equations from regions governed by the dynamic plastic equations is presented. The nature of the discontinuities that occur at these boundaries are also discussed. For the finite bar case the analysis is given for materials which exhibit isotropic work hardening and for materials for which the stress-strain behavior in tension is independent of any previous compression. The main features of the solution are in agreement with the behavior observed for annealed, commercially pure aluminum bars subjected to explosive loading at one end. These experiments will be reported subsequently. Author

N65-26954# Hayes International Corp., Huntsville, Ala.
PLANE THERMAL STRESS ANALYSIS OF THICK-WALL CYLINDERS. VOLUME I: AXISYMMETRICAL TEMPERATURE DISTRIBUTION
Floyd J. Stanek 15 Jan. 1964 42 p refs Sponsored by AEC
(HIC-1-1564-2, Vol. I)

This volume presents, in a convenient and useful manner, the procedure for the application of the fundamentals for the thermal stress analysis of thick-wall cylinders subjected to a temperature distribution which is symmetrical about the central axis and uniform along the length; in other words, the temperature distribution must be a function of the radial coordinate only. The formulas and the procedure are presented in each of two coordinate systems: a regular coordinate system and a dimensionless coordinate system. The procedure is explained and then illustrated with a significant number of examples for each system. A plane strain condition or a plane stress condition with transversally isotropic or completely isotropic material may be taken into account during the analysis. The formulas for plane strain were developed to enable the strain to appear in the analysis as an arbitrary constant (not necessarily zero). Most any temperature distribution which is a continuous function of the radial coordinate may be used in the analysis with the formulas in the regular coordinate system. The use of the formulas in the dimensionless coordinate system reduces the amount of detailed calculations by a large degree when a certain set of numerical values are available. A set of such numerical values are made available in each of several useful temperature distributions. The derivations of the formulas for the analysis are given in Part II. It is not necessary to understand the derivation in order to understand the application. Author

N65-26984# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
TRANSVERSE VIBRATIONS OF NON-UNIFORM FREE–FREE BEAMS
William F. Bozich (M.S. Thesis) Aug. 1962 169 p refs p refs
(GAE/MECH-62-4; AD-610230)

Transverse vibrations in one plane of a non-uniform, free-free beam are considered, which include the effects of rotary inertia, shear deflection, and a constant axial acceleration, which is provided by an axial thrust at one end of the beam. The equations of motion are derived. An energy formulation for approximate solution of the natural frequencies, and a matrix formulation for the approximate solution of the natural frequencies and mode shapes are derived, which include these effects. Both formulations are altered to give the critical axial acceleration for buckling. It is shown that rotary inertia, shear deflection, and axial acceleration all reduce the natural frequency of vibration, however the first two effects are important in short beams, while the latter effect is important in long slender beams. Author

N65-26995# Thompson (H. I.) Fiber Glass Co., Gardena, Calif. Research and Development Div.
INVESTIGATION OF STRUCTURAL PROBLEMS WITH FILAMENT WOUND DEEP SUBMERSIBLES Final Report, 17 Jan. 1963–16 Jan. 1964
N. C. Myers, G. D. Lee, F. C. Wright, and J. V. Daines Jan. 1964 117 p
(Contract NObs-88351)
(RDD-2994; AD-440273)

This program investigated some of the structural problems originating in the application of the filament-wound composite to the hulls of deep-diving vehicles. Small scale models were designed, fabricated and tested under static and cyclic external pressure. A design collapse pressure of 13,333 psi, and 10,000 cycles to one-half of this pressure were program objectives. Problems of major concern were closures, closure attachment, closure and cylinder penetrations, transverse cylinder joints, and positive frame attachments. Author

N65-27161# Naval Ordnance Test Station, China Lake, Calif. Research Dept.
THEORETICAL INVESTIGATION OF THE DYNAMIC BEHAVIOR OF THE MERCURY DAMPER
Prescott D. Crout Nov. 1964 126 p
(NAVWEPS-8611; NOTS-TP-3635; AD-615508)

The dynamic behavior of the mercury damper is investigated. Particular attention is paid to the eccentric annular mercury configuration, which is the final continuous ring phase which occurs in the operation of all mercury dampers. In this phase the damping is the poorest, and the system is closely linear. The crescent, or broken-ring, case is also considered. During the course of the investigation the hydrodynamic problem is treated as three dimensional, and extensive use is made of a variational principle of least viscous frictional power loss, which is derived. A variational principle of least constraint is also used to advantage. Formulas for calculating the behavior of the mercury damper are obtained. Author

N65-27165# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
AN EXPERIMENTAL STUDY OF ARCHING IN SAND
James Walsh Mc Nulty (Ph.D. Thesis, Illinois Univ.) May 1965 188 p refs Sponsored by DASA
(TR-1-674; AD-615511)

Arching, the ability of a material to transfer load from one area to another in response to relative displacements between areas, is investigated. The study is primarily experimental, results being used to assess the applicability of existing theories. The major experimental results are a series of dimensionless load-deflection curves obtained by moving an axially symmetrical trapdoor, which was initially mounted flush with the bottom of a cylindrical test chamber, up into or down away from a series of sand specimens of various depths. The sand surface was subjected to several levels of pneumatic surcharge (0, 40, 75, 100 psi), the majority being at 75 psi. Two sands and two trapdoor sizes were used. Also the redistribution of vertical

stress on the test chamber base was measured by several pressure cells located at various distances from the trapdoor. Analysis of the dimensionless load-deflection data leads to the conclusion that extremely small deflections have great significance.
Author

N65-27219# Hayes International Corp., Huntsville, Ala.
STRESS ANALYSIS OF FLAT CIRCULAR PLATES
Floyd J. Stanek 15 Sep. 1963 30 p refs Sponsored in part by AEC
(HIC-9-1563-1)

The report presents in a convenient and usable form the procedure for the stress analysis of flat circular plates, loaded symmetrically with respect to the central axis of the plate. The fundamentals for this procedure are well known in the classical theories of elasticity and of plates and shells; however, the application of these fundamentals has not been presented in a convenient and useful manner. It is the intent of this report to bridge the gap between theory and application for design. This report contains application, illustrative examples, and derivations. The plate formulas required for a complete stress analysis are tabulated, and application is explained. A complete set of values of all necessary functions are provided. The use of these tabulated values during the application of the formulas are illustrated with a sufficient number of significant examples. The derivation of all necessary formulas and functions are given. It is not necessary to understand the derivation in order to understand the application.
Author

N65-27259 Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.
BENDING TEST OF ANGULAR ROTATION OF CORRUGATED U-SHAPED BELLOWS SUBJECTED TO INTERNAL PRESSURE
H. Sakai *In its* Rept. of the Inst. of High Speed Mech. [1965] p 51–72 refs Presented at 37th Gen. Meeting of the Japan Soc. of Mech. Engr., 3 Apr. 1960 (See N65-27256 16-12)
(Rept.-153)

For the purpose of applying the corrugated U-shaped bellows as the hinged expansion joint and the flexible seal the bending tests of angular movement on several U-shaped bellows were performed under internal pressure. By measuring of angular rotation and required torque, the relation between apparent flexural rigidity and internal pressure was clarified. And by devising the various equalizing rings considered to supply pressure proof strength, the effects of the different rings were clarified. Further, on the bellows thought to be useful, their endurance properties in the repeated bending test were made clear.
Author

N65-27260 Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.
ON CUMULATIVE DAMAGE IN IMPULSE FATIGUE TESTS
S. Tanaka *In its* Rept. of the Inst. of High Speed Mech. [1965] p 73–83 refs Presented at 38th Gen. Meeting of the Japan Soc. of Mech. Engr., 5 Apr. 1961 Submitted for Publication (See N65-27256 16-12)
(Rept.-154)

Experimental results are presented for fatigue failure of mild steel specimens under repeated application of lateral impulses; the cumulative damage effect as a result of stresses arising from free-damped vibration of the specimen in the intervals between the repeated impulses is studied. A discussion on the conformity of these results with Miner's hypothesis is given.
Author

N65-27292*# Florida Univ., Gainesville. Dept. of Engineering Science and Mechanics.
RESEARCH INVESTIGATIONS OF BULKHEAD CYLINDRICAL JUNCTIONS EXPOSED TO COMBINED LOAD, CRYOGENIC TEMPERATURE. PART IV: THEORETICAL ANALYSIS OF THE BUCKLING PROBLEM
Tsu-Te Wu and H. Wagner Aug. 1964 69 p refs
(Contract NAS8-5199)
(NASA-CR-63477) CFSTI: HC $3.00/MF $0.75 CSCL 20K

The stability problem of a missile liquid propellant tank is discussed for the case of buckling of the knuckle joint between a cylindrical shell and a semielliptical bulkhead under axial tension. A shell of revolution under axial tension will buckle primarily at its knuckle part. Thus, it is possible to examine the buckling behavior of a truncated semielliptical shell of revolution instead of a complete semielliptical shell by introducing adequate boundary conditions. It is observed that the critical load of tension increases with the increase of internal pressure. This indicates that internal pressure will decrease the degree of buckling of this type of shell. Further, it is shown that there is an approximate linear relation between critical tension load and internal pressure for this particular problem. Buckling forces for various internal pressures are tabulated; the derivation of differential operators for revolutionary shells and of force components in the buckled shell are given.
E.E.B.

N65-27374*# ARA, Inc., West Covina, Calif.
HIGH ENERGY SHOCK ABSORBER AND STRUCTURAL OVERLOAD DEVICES Final Report, Jul. 1964–May 1965
D. L. Platus 4 Jun. 1965 48 p refs
(Contract NAS8-11687)
(NASA-CR-63602; ARA-60) CFSTI: HC $2.00/MF $0.50 CSCL 13M

Results of an 11-month research and development program are described which cover an analytical and experimental study and the design and fabrication of five advanced energy absorbing devices, utilizing the principle of cyclic deformation of materials. The study represents a continuation of research on cyclic-strain energy-absorbing devices previously conducted at ARA, Inc. Energy absorption, fatigue, and plastic stability of rotating torus segments were studied analytically and experimentally, using rotating beam tests. Design procedures for torus devices utilizing friction drive are presented. These results were applied to the design and fabrication of energy absorber units providing up to 53,300 lb force over a 36-inch stroke, and capable of multiple operation in tension and compression.
Author

N65-27396*# Astro Research Corp., Santa Barbara, Calif.
MECHANICS OF A CONED ROTATING NET
Richard H. MacNeal Washington, NASA, Jul. 1965 76 p refs
(Contract NAS7-272)
(NASA-CR-248) CFSTI: HC $3.00/MF $0.75 CSCL 20K

The deformations, stresses, and vibration modes of a rotating net in a hypersonic air stream are analyzed. Particular emphasis is placed on the "isotensoid" net of fiber circles that has the property that fiber stress is everywhere equal when the spinning net is flat. Numerical solutions are obtained for the large motion static deformations and stresses in an axisymmetric hypersonic air stream including the effects of tip weights, hub radius, etc. General expressions are written for the potential and kinetic energies for small perturbations from an axisymmetric state of equilibrium. These expressions are used to obtain numerical solutions for a variety of vibration problems including in-plane and out-of-plane vibrations of a flat net and the coupled vibrations of a statically deformed net.
Author

N65-27409# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
AN EXPERIMENTAL STUDY OF HIGH VELOCITY IMPACT AT NORMAL AND OBLIQUE INCIDENCE ON MULTIPLE, SPACED 2024-T3 ALUMINUM PLATES. GENERAL MODEL

D. P. Hickey Jun. 1965 19 p refs
(SM-47873)

An experimental investigation was made of projectile impact on multiple, spaced 2024-T3 aluminum plates at incident projectile velocities on the order of 13,000 ft./sec. The leading plate was either 1/4 in. or 1/16 in. in thickness, with succeeding plates of 1/8 in. in thickness. The spacing between plates was 1-3/4 in. (measured normal to the front plate from the back of the front plate to the front of the following plate). Projectile impact occurred at normal (0°) and oblique (60°) incidence. The projectiles were solid copper and annealed steel spheres of 3/16 in. nominal diameter. The results obtained showed that no more than two plates were completely penetrated. For normal impact, it was found that the hole diameter could be predicted from existing empirical relations. Author

N65-27417# IIT Research Inst., Chicago, Ill.
STUDIES OF REACTOR CONTAINMENT. VOLUME I: DETERMINATION OF THE EQUATION OF STATE OF A POROUS SOLID Final Report
Paul Lieberman [1961] 298 p refs
(Contract AT(11-1)-578)
(IITRI-578-P21-9; Vol. I) CFSTI: $6.00

A helium/air shock tube is designed to give controlled blast waveforms for impingement against a porous solid contained in a special specimen holder. The sensors in the specimen holder are arranged to detect elastic wavefront, plastic wavefront, reflected plastic wavefront, unloading wavefront, particle velocities in the crushing solid, and gas pressure in the impingement gases. The data records are interpreted in terms of a wave diagram from the pressure-time histories at several stations along the specimen holder. The wave diagrams for several blast impingement pressures are combined to construct the equation of state of the porous solid in loading and in unloading. The Hugoniot up to 1,700 psi is determined for balsa wood by a series of twenty tests. Since no temperature, strain-rate, and friction effects were detected in these tests, the dynamic and static stress-volume relations are equal. Three unloading paths for balsa, each test conducted with wood of the same specific gravity, were determined by three additional tests. The unloading paths are originated from 15,450-, 9,400-, and 6,650-psi states. The additional Hugoniot data contain no temperature or strain-rate effects, but do show that wall friction effects at the high-stress amplitudes are reduced in the dynamic tester, as compared with the static tester. The unloading isentrope paths from each of the Hugoniot points is shown by two straight lines in the stress-volume plane, and the slope of the isentrope path is steeper with increased severity of blast impingement. Author

N65-27529# General Technology Corp., Elgin, Ill.
STRESS DISTRIBUTION AT TWO NORMALLY INTERSECTING CYLINDRICAL SHELLS
A. C. Eringen and E. S. Suhubi Apr. 1965 46 p refs
(Contract NObs-90157)
(TR-3-7; AD-465696)

The boundary value problem concerned with the state of stress in two normally intersecting circular cylindrical shells subjected to internal pressure is formulated. The differential equations of the two shells are solved for a small ratio of radii ($\rho_0/R < 1/3$) subject to edge conditions along the intersection curve and at the ends of the cylinders. The numerical results will be published in a later paper. Author

N65-27622# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REPORTS OF THE ACADEMY OF SCIENCES OF UKRAINIAN SSR. (SELECTED ARTICLES)
L. F. Shulezhko et al 15 Feb. 1965 16 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 1, 1964 p 10–14, 54–58
(FTD-TT-64-919/1; AD-611525)

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2. CONCENTRATION OF STRESSES AROUND AN ELLIPTICAL HOLE IN A SPHERICAL SHELL G. M. Savin and O. M. Guz' p 7–12 refs (See N65-27624 16-32)

N65-27623 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RAISING THE STABILITY OF FLEXIBLE PLATES AND CYLINDRICAL PANELS WITH THE AID OF VIBRATIONS
L. F. Shulezhko *In its* Rept. of the Acad. of Sci. of Ukrain. SSR 15 Feb. 1965 p 1–6 refs (See N65-27622 16-32)

The author considers nonlinear equations of the dynamic stability of flexible plates and cylindrical panels. The effect of compressive vibrational forces of high frequency on the stability of plates and panels is investigated. Author

N65-27624 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCENTRATION OF STRESSES AROUND AN ELLIPTICAL HOLE IN A SPHERICAL SHELL
G. M. Savin and O. M. Guz' *In its* Rept. of the Acad. of Sci of Ukrain. SSR 15 Feb. 1965 p 7–12 refs (See N65-27622 16-32)

A solution is obtained for the indicated problem by the method of "perturbation of the boundary shape" [3]. The zero (3), first (4) and (5) and second (6), (7), (8), (9) approximations are considered. The values on the contour of the hole, taking into account the second approximation are determined from formula (10). A numerical example is presented, which shows the effect of the ellipticity of the hole on the coefficient of force conservation. In comparison with solution [1] the solution obtained may be applied with a considerably greater value of eccentricity. Author

N65-27634# Bureau of Ships, Washington, D. C.
A PRELIMINARY HYDROFOIL DESIGN INCORPORATING A CAVIATATION FREE OPERATION REQUIREMENT
William D. Bauman Dec. 1964 34 p refs With Appedices A, B, and C
(Ser -420-54; AD-612672)

A procedure for designing hydrofoils with primary consideration given to avoiding cavitation is discussed in advance of tests on models. A single gas-turbine engine was selected as the power plant, and a conventional configuration associated with a single power nacelle aft and retraction of the forward foils in a transverse plane over the gunwales was chosen. Calculations of mean depth at which the foils will operate, and the center of the two-dimensional cavitation range, were made. A nomograph devised as a means of portraying the interrelations of a number of hydrofoil design parameters is given and discussed. A method of calculating the lift and drag characteristics of subcavitating hydrofoils operating near the free-surface is described. J.M.D.

N65-27675*# National Aeronautics and Space Administration, Washington, D. C.
A MATRIX METHOD FOR THE ANALYSIS OF BENDING VIBRATIONS, BASED ON THE DEFORMATION TECHNIQUE [EIN MATRIZENVERFAHREN ZUR BEHANDLUNG VON BIEGESCHWINGUNGEN NACH DER DEFORMATIONSMETHODE]

R. Zurmühl May 1965 30 p refs Transl. into ENGLISH from Ing.-Archiv. (Berlin), v. 32, 1963 p 201–213
(NASA-TT-F-9335) CFSTI: HC $2.00/MF $0.50 CSCL 13M

A matrix method, using a so-called deformation method for computing vibrating beams and frames of intricate configuration, is described, with construction schemes for stiffness and flexibility matrices. The system is based on an elementwise computation of strain, using flexure and torsion as system coordinates and yielding higher accuracy at less matrix rows. Variable cross sections, shearing strain, torsional inertia, etc. of two-dimensional frames and beams are covered by the method, which can be extrapolated also to three-dimensional systems under torsion and is suitable for digital computer programming. Numerical data on a conventional iteration process are given for calculating higher eigenvalues and for treating singular stiffness matrices. Author

N65-27720*# National Aeronautics and Space Administration, Washington, D. C.
INFLUENCE OF THE EDGES OF THE TIPS ON THE MOTION OF THE WING WITH VIBRATIONS AT SUPERSONIC SPEED [VLIYANIYE KONTSEVYKH KROMOK PRI DVIZHENII KRYLA s VIBRATSIYAMI SO SVERKHZVUKOVOY SKOROST'YU]
Ye. A. Krasil'shchikova Jul. 1965 4 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 58, no. 5, 1947 p 761–762
(NASA-TT-F-9440) CFSTI: HC $1.00/MF $0.50 CSCL 20K

It was previously shown that to determine $\partial\phi/\partial z$ in the region of the wing tip with wing vibration it was necessary to transform the integral equation

$$\int_0^x \int_{\phi(\xi)}^{y} \frac{\Theta(\xi,\eta)\cos\left[\lambda\sqrt{(x-\xi)(y-\eta)}\right]}{\sqrt{(x-\xi)(y-\eta)}}\,d\eta d\xi = -\int_a^{x(y)} \int \frac{A(\xi,\eta)\cos\left[\lambda\sqrt{(x-\xi)(y-\eta)}\right]}{\sqrt{(x-\xi)(y-\eta)}}\,d\eta d\xi$$

relative to a function of (x, y). In this note it is shown that the solution of this integral equation can be presented in the form of an absolutely convergent line for any values of the parameter λ. E.E.B.

N65-27726# Advisory Group for Aeronautical Research and Development, Paris (France).
THE PRESENT STATUS OF PANEL FLUTTER
D. J. Johns (Loughborough Coll. of Tech., England) Oct. 1964 44 p refs
(AGARD-484)

Methods of analysis and assumptions are reviewed for various panel configurations and boundary support conditions and, where possible, theoretical and experimental results are compared and correlated. It is concluded that there is still not a satisfactory set of design criteria for various structural configurations and flight regimes. Author

N65-27735# Advisory Group for Aeronautical Research and Development, Paris (France).
SOME OBSERVATIONS ON MISSILE VIBRATION FLIGHT RESULTS AND THE DIFFICULTIES OF THEIR PREDICTION
B. E. Grant (Roy. Aircraft Estab., Bedford) Jun. 1964 21 p
(AGARD-497)

Early recognition of the difficulties of prediction of missile vibration by analytical or modelling techniques, especially at frequencies above those corresponding to principal body modes, led to an expensive programme of direct measurement on British rockets and missiles. Some observations are made on selected measurements which confirm the difficulties of predicting higher frequency modes and levels but suggest that for the purpose of proof testing of equipment, prediction of mode frequencies is usually of less importance than predicting the order of mean spectral density level. There is yet no acceptable means of predicting entirely analytically in this axis either, so that any generalization must involve a major portion of empiricism. Some particular results are presented to show how the problems are aggravated by rapidly changing environments, kinetic heating, and variation between nominally identical missiles. Author

N65-27736*# Texas Univ., Austin. Dept. of Civil Engineering.
STATIC LOAD VERSUS SETTLEMENT FOR GEOMETRIC SHAPES ON COHESIONLESS SOIL
Raja A. Iliya and Lymon C. Reese May 1965 61 p refs
(Grant NsG-604)
(NASA-CR-63715) CFSTI: HC $3.00/MF $0.75 CSCL 08M

The bearing capacities and settlements of rigid-surface, spherical and conical foundation elements on sand of medium density were observed experimentally in static tests. Results were compared with those established by this investigation for circular plates loaded under the same conditions on the same type of sand. Equations for determining the bearing capacity of a cone and sphere were developed by theory and were supported by the experimental results. The bearing capacity and settlement, as a function of the thickness of soil layer, were investigated to establish depth of soil beyond which values of either stay constant. This investigation led to the conclusion that the bearing capacity of foundation elements with circular projected areas is a function of the cross-sectional diameter in the plane of the ground surface and varied directly with respect to this diameter. As an example of this point, it was observed that the bearing capacity of two spheres of differing spherical diameters was the same if the cross-sectional areas at the plane of the ground surface were the same. Author

N65-27737*# Dynamic Science Corp., South Pasadena, Calif.
A DIGITAL COMPUTER PROGRAM FOR THE GEOMETRICALLY NONLINEAR ANALYSIS OF AXISYMMETRICALLY LOADED THIN SHELLS OF REVOLUTION
R. E. Ball and C. A. Bodeen 22 Mar. 1965 27 p refs Prepared for JPL
(Contract NAS7-100)
(NASA-CR-63703; SN-38-5) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A digital computer program was developed for the geometrically nonlinear analysis of thin shells of revolution subjected to axially symmetric loads and thermal gradients. The program is based upon a proportional loading concept and automatically solves the nonlinear equations for the displacements, rotations, internal forces, bending moments, and stresses at an arbitrary number of locations along the meridian at each load step. R.W.H.

N65-27749# Library of Congress, Washington, D. C. Aerospace Technology Div.
NUCLEAR WEAPONS EFFECTS: COMPREHENSIVE REPORT Surveys of Soviet-Bloc Scientific and Technical Literature
14 Jan. 1965 24 p refs
(ATD-P-65-1; AD-610054)

Recent Soviet open literature dealing with the effects and simulation of nuclear explosions is reviewed in three sections. The first is concerned with the structure and parameters of strong shock waves in gases and solids. The second deals with the propagation of strong shock waves and their interaction with materials in terms of dynamic compression of materials, collisions of shock waves and metals at high velocities, and

explosions of solid bodies at high velocities. The last section, Meteorite Analogy, is considered significant because it reflects Soviet interest in the use of meteorites to simulate the effects of high power, and especially nuclear, explosions. The 1908 explosion of the Tungusk meteorite/comet is discussed. A bibliography with 68 references is included. M.W.R.

N65-27753# Hexcel Products, Inc., Berkeley, Calif.
DEVELOPMENT AND EVALUATION OF A LIGHTWEIGHT ALUMINUM HONEYCOMB CASE Monthly Progress Report
E. C. Vicars 17 Nov. 1964 18 p
(Contract DA-04-200-AMC-477(A))
(MPR-9; AD-610757)

During the report period, cases HXL-9-477 and HXL-10-477 were fabricated and tested. Design modification and results from hydrostatic pressure and impact testing are given. Motion pictures were taken to provide a visual record of the environmental test performed on cases HXL-8-477 and HXL-10-477. N.E.A.

N65-27790# Andrews Associates, Inc., Oklahoma City, Okla.
ARCHITECTURAL AND ENGINEERING SERVICES FOR STUDIES OF STRUCTURAL RESPONSE TO SONIC BOOMS IN CONNECTION WITH THE SUPERSONIC TRANSPORT RESEARCH PROGRAM, VOLUME I Final Report
Don K. Andrews, Glen W. Zumwalt, Richard L. Lowery, James W. Gillespie, and Douglas R. Low 5 Feb. 1965 241 p refs Prepared jointly with Hudgins, Thompson, Ball and Associates, Inc., Oklahoma City, Okla.
(Contract FA-64-AC-6-526)
(AD-610822)

Results of structural and dynamic responses of residential structures in Oklahoma City during a 39-week testing program consisting of 26 weeks of 8 daily controlled sonic booms, followed by 13 weeks of observation and inspection of the structures to determine the rate of normal deterioration as compared to the rate of deterioration found during the sonic boom period; and shock wave measurements of the sonic booms are reported. Evidence of significant damage to test houses was not produced. The wavelengths of the aircraft used range from 0.08 to 0.18 sec and their natural frequencies are similar to the natural frequencies of the test house structural elements (about 5 to 30 cycles per second). The proposed supersonic transport will have a wavelength of about 0.5 seconds, and will be matched with structural elements having natural frequencies of about 2 cycles per second for a wave involving no reflections. No conclusive evidence was found that obviously prohibits structurally tolerable operation of a supersonic transport aircraft over populated areas. L.S.

N65-27800# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPROXIMATION METHOD OF SOLVING ELASTIC-PLASTIC PROBLEMS
P. I. Perlin 4 Dec. 1964 10 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Inst. Mekh. Inzh. Sb. (USSR), v. 28, 1960 p 145–150
(FTD-TT-64-424/1+2; AD-610795)

A method for solving elastic-plastic problems in the case of flat-deformed and flat-strained conditions is presented. Solutions in which the strained state in the plastic zone is determined independently of the solution of the elastic-plastic problem are examined. J.M.D.

N65-27805# IIT Research Inst., Chicago, Ill. Technology Center
SOME OBSERVATIONS ON THE BIAXIAL COMPRESSIVE CREEP PERFORMANCE OF FILAMENT WOUND LAMINATES Special Technical Report, Oct. 1, 1962–Aug. 31, 1964
B. W. Abbott Aug. 1964 31 p refs
(Contract NObs-90329)
(AD-610539)

A discussion of the biaxial compressive creep performance of glass reinforced plastics, which is centered about an experimental study, is presented. Techniques used to measure creep strains and deformations are discussed and illustrated. The results of several series of experiments aimed at characterizing the creep behavior of the glass reinforced plastics studied are presented and discussed. Author

N65-27808# Battelle Memorial Inst., Columbus, Ohio.
ANALYSIS OF THEORETICAL AND EXPERIMENTAL DATA FOR REINFORCEMENT OF OPENINGS IN PRESSURE VESSELS
E. C. Rodabaugh and T. J. Atterbury 30 Jun. 1964 41 p refs
(Contract W-7405-ENG-92)
(PR-5)

This research program in progress on the analysis of theoretical and experimental data for reinforcement of openings in pressure vessels covers work on the following general subjects: (1) stresses in cylinder-to-cylinder connections with internal pressure load; (2) stresses in cylinder-to-cylinder connections with transverse or in-plane bending loads on the nozzle; (3) design rules for cylinder-to-sphere connections with internal pressure load; and (4) stresses in cylinder-to-sphere connections with bending loads on the nozzle. N.E.A.

N65-27817*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
FLUTTER INVESTIGATION OF STREAMWISE-ORIENTED ARRAYS OF CURVED PANELS UNDER COMPRESSIVE LOADING AND AERODYNAMIC HEATING
Robert W. Walker, Richard Rosecrans, and William D. Deveikis Washington, NASA, Jul. 1965 31 p refs
(NASA-TN-D-2910) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Two large-scale cylindrical segments consisting of nine longitudinal arrays of rectangular curved panels were tested to study the flutter characteristics of panels subjected to compressive loading and aerodynamic heating. The tests were conducted at a Mach number of 3, constant dynamic pressures from 1600 to 3500 psf (77 to 168 kN/m^2), and a stagnation temperature of 300° F (422° K). A flutter boundary was obtained which indicated that the flutter trends of the curved panels are similar to those obtained for stressed, flat panels. The influence of adjacent panels on the flutter of a given panel was found to be insignificant. The results also showed that panel curvature had a stabilizing effect relative to the minimum dynamic pressure required to initiate flutter of flat panels. Author

N65-27863# ARO, Inc., Arnold Air Force Station, Tenn.
STRESS WAVES IN COMPOSITE LAMINATES
Ray Kinslow Arnold Eng. Develop. Center, Jun. 1965 106 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-69; AD-465129)

Fractures caused by stress waves resulting from hypervelocity impact are sometimes reduced, and at other times are increased, by the use of laminated materials. An analysis of some of the parameters which affect the ability of a laminated structure to resist fracture following impact has been conducted. It is shown that there are multiple reflections from the interfaces bounding any layer of material. The amplitudes of these waves attenuate very rapidly, but because their transmitted components may combine in phase with other waves, they sometimes contribute substantially to the total stress produced. It is shown that these combined waves may result in a stress

much greater in the laminated material than would have been produced by the same impact on a solid target of either of the materials used; however, under other conditions, the laminate may be employed to reduce the stress to a very small value. Pressure pulse amplitudes in materials having impedance mismatch values ranging from 0.1 to 10.0 and having as many as thirty laminations are presented in both graphical and tabular form. Author

N65-27895# Wyle Labs., Inc., Huntsville, Ala. Testing Div.
DISLOCATION SLIP PLANES AND SHEAR CRACKS IN ORTHOTROPIC MEDIA
Nazeer Ahmed May 1965 18 p refs
(WR-65-11)

The elastic stress field in the vicinity of a dislocation slip plane in an infinite orthotropic medium subjected to uniform shear at infinity is determined using a formulation integral equations. It is assumed that a slip plane is different from a traction free surface crack in that it has uniform shear on its surface and remains closed under the applied stress field. However, the use of these mixed boundary conditions under the restrictions of plane stress in linear elasticity is found to give the same stress distribution as that for a shear crack. Although a shear crack under an applied uniform shear opens up into an ellipse, the opening per unit length is shown to be so small that for most engineering applications it can be considered closed and the equivalence of a shear crack and a slip plane is established. It is pointed out that this correspondence is not valid between a shear crack in a thick elastic plate and a slip plane in an infinite elastic medium. Results for an isotropic body are given as a limiting case of an orthotropic body. Author

N65-27904# Army Materials Research Agency, Watertown, Mass. General Thomas J. Rodman Lab.
UNIDIRECTIONAL SOLIDIFICATION IN HIGH-STRENGTH STEEL CASTINGS
Paul J. Ahearn and Francis C. Quigley Mar. 1964 13 p refs Presented at the 18th Ann. Tech. and Operating Conf. of the Steel Founders Soc. of Am., Nov. 1963
(AMRA-MS-6403; AD-610659)

A unidirectional solidification technique was compared experimentally to conventional solidification methods and was found to produce superior mechanical properties in steel castings. A unidirectional solidification is obtained by rapid extraction of heat from a single surface of the casting while other surfaces are insulated, and it is associated with the formation of long columnar dendrites in the casting. There is a marked effect of mass on the mechanical properties of high-strength steel castings solidified in a conventional manner, while unidirectional material does not appear to be sensitive to the mass effect. The possibility of a correlation between the mechanical properties of unidirectionally solidified castings and the dendritic parameters of arm spacing or cross-arm length was discovered. This new method was used in manufacture of a massive production-type casting. J.M.D.

N65-27912# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STABILITY OF SHELLS OF REVOLUTION: GENERAL THEORY AND APPLICATION TO THE TORUS
W. Flügge and L. H. Sobel (Ph.D. Thesis, Stanford Univ.) Mar. 1965 149 p refs
(LMSC-6-75-65-12)

The stability of a general shell of revolution subject to arbitrary loads was investigated, and the elastic law which relates the incremental stress resultants to the incremental displacement components was derived. The equations of equilibrium were applied to a differential element of the deformed shell to obtain partial differential equations which are linear and homogeneous in the incremental quantities. The specification of the linear and homogeneous boundary conditions results in an eigenvalue problem. By specialization of three ordinary differential equations for the three incremental displacement components, the ones governing the stability of a toroidal shell subject to a uniform external pressure were obtained. Finally, equations for the free vibrations of a pre-stressed shell of revolution are derived and then specialized for the toroidal shell subject to external or internal pressure. E.E.B.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-26812# Atomic Energy Commission, Washington, D. C. Div. of Reactor Development.
PROCEEDINGS OF THE SECOND JOINT USAEC–EURATOM TWO-PHASE FLOW MEETING
Ronald M. Scroggins, ed. Nov. 1964 516 p refs Meeting held at AEC, Germantown, Md., 29 Apr.–1 May 1964
(CONF-640507) CFSTI: $5.50

Conference papers are presented on two-phase heat transfer, hydraulic and boiling stability, and fluid dynamics. For individual titles see N65-26813–N65-26854.

N65-26813 Atomic Energy Commission, Washington, D. C. Div. of Reactor Development and Technology.
JOINT TWO-PHASE FLOW PROGRAM
R. M. Scroggins *In its* Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 3–8 (See N65-26812 16-33) CFSTI: $5.50

Proceedings of the second Joint USAEC–EURATOM Two-Phase Flow Meeting held at the USAEC Headquarters are presented. The meeting was divided into five sessions, which are: (1) heat transfer—water; (2) heat transfer—liquid metal, (3) methods to increase two-phase heat transfer; (4) two-phase hydraulic and boiling stability; and (5) two-phase fluid dynamics. The papers presented at the meeting related to progress in the field and status of research under the joint program. Outstanding problem areas and questions which are not yet resolved and demand further investigation are presented. Some of the problem areas discussed were: (1) critical heat flux; (2) boiling instabilities; (3) two-phase flow fluid dynamics; (4) boiling regions; (5) uniformity in the area of instrumentation; and (6) data record- N.F.A.

N65-26814 European Office of Aerospace Research, Brussels (Belgium).
PRESENTATION OF THE EURATOM PROGRAM
Rene Morin *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 9–11 (See N65-26812 16-33) CFSTI: $5.50

From the onset, the EURATOM program in two-phase flow under the Joint U.S.-EURATOM Research and Development Program has been designed to promote research in boiling water heat transfer and help a number of European laboratories to reach a good level of knowledge in this field. In the second phase, which is now in progress, the majority of the studies have been directed towards optimization of boiling water reactors. This program comprises both basic and applied studies. Contracts that are carried out under the Joint program are described and the programs currently under way are presented. N.E.A.

N65-26815 European Office of Aerospace Research, Brussels (Belgium).
FUNDAMENTAL STUDIES IN BOILING
René Morin *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 15–16 refs (See N65-26812 16-33) CFSTI: $5.50

A schlieren film is presented which shows the experimental determination of the influence region of vapor bubbles in boiling liquids. In the experiment, a horizontal rod is electrically heated in a vessel containing water under atmospheric pressure the heating generates a convective flow thus giving rise to the formation of a boundary layer. Making use of the schlieren effect, the bubble generation and its influence on the temperature distribution in the surrounding liquid are recorded with high speed camera. Conclusions drawn from the film are presented. On the same film, wall temperature fluctuations during nucleation are studied. In this research, a new technique is used which allows correlation of bubble growth and the wall temperature fluctuations. Conclusions from this work are also presented. N.E.A.

N65-26816 Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
VISUALISATION OF SATURATED AND SUBCOOLED POOL BOILING BY SCHLIEREN-PHOTOGRAPHY
J. Villeneuve *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 17–18 refs (See N65-26812 16-33) CFSTI: $5.50

A film is presented which shows some sequences of boiling using the schlieren-cinematography method. The schlieren-cinematography apparatus is composed of a linear light source, a system of lens, and a pool boiling vessel with heated wire or platinum. An occulation device at the focus of the lens system allows one to see in the film only the beam deviated by the variation of the water refraction index due to the temperature differences. For color film, the occulation device is replaced by a slide having stripes of different colors so that different colors on the film depending on the the deviation of the beam in the heated water around the test element are obtained. With this device, an appreciation of the temperature variations near the heated test element is obtained after calibration. The sequences shown were taken at atmospheric pressure and a description of each is given. N.E.A.

N65-26817 Maschinenfabrik Augsburg-Nurnberg A.G., Nuremberg (West Germany).
INVESTIGATIONS INTO THE CRITICAL HEAT FLUX (BURNOUT) IN BOILING
F. Mayinger *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 19–32 refs (See N65-26812 16-33) CFSTI: $5.50

A study of the influence of the flow conditions prevailing at the inlet of a channel on the critical heat flux in boiling is discussed. The measurements are being carried out on internally cooled, round tubes with diameters ranging from five to 15 mm. Points of special interest are the influence on the transition between nucleate and film boiling of the length/diameter ratio of the test channel and the influence of the history of the flow. Flow history in this context is defined as the influence of the type of flow prevailing at the inlet of the test channel. The study provides for the length/diameter ratio to be varied between 20 and 100. In order to ensure continuity with research efforts elsewhere the tests were started in the range between 100 and 400 atms., the emphasis being on the upper range up to about 210 atms. A description of the test rig and measuring equipment is given. The present status of the work and future research are discussed. N.E.A.

N65-26818 Dynatech Corp., Cambridge, Mass.
INVESTIGATION OF TWO-PHASE FLOW AND BURNOUT
M. Suo *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 33–36 (See N65-26812 16-33) CFSTI: $5.50

A program concerned with the investigation of burnout in two phase boiling systems has begun in order to gain a better understanding of the mechanism of forced convection burnout. In the first phase of the program the objective is to obtain experimental information about flow regimes in heated tubes before and at burnout and to determine how well they can be predicted. The existence of oscillations in flow in the test section is also to be investigated. The experimental facility is being designed and is shown in schematic form. The components of interest are the flow regime probe, the sight section, and the pressure transducer. These are discussed briefly. The experimental program is designed to obtain data over a range of flow conditions. These conditions are: (1) tube diameter—0.4 inches; (2) tube length—two to eight feet; (3) mass velocity—0.4×10^6 to 4×10^6 lbm/ft hr; and (4) pressure—1,000 psia. N.E.A.

N65-26819 Babcock and Wilcox Co., Alliance, Ohio. Alliance Research Center.
NON-UNIFORM HEAT GENERATION EXPERIMENTAL PROGRAM
H. S. Swenson *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 37–44 refs (See N65-26812 16-33) CFSTI: $5.50

A project is described whose objective is to determine the influence of nonuniform heat flux distribution on burnout. Tests will be run with uniform distribution and the nonuniform distributions chopped cosine, inlet peak, and outlet peak. Flow will be vertically upward in a 6 ft long flow channel, 0.4 inch nominal inside diameter. Both tubular and annular test sections will be tested with axial profiles as designated A diagram of the test section arrangement is shown. The ranges of operating conditions over which the tests will be run are given. Pressure, flow, tube wall temperature, and voltage drop will be recorded continuously during the tests in order to detect any fluctuations that may occur in these operating variables. Direct current power to the test section is supplied by transformers controlled by saturable core reactors and silicon rectifiers. The burnout detector utilizes the change of resistance of the test section at burnout as the signal to reduce power. A schematic diagram and a photograph of the loop is shown. N.E.A.

N65-26820 Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.
OBSERVATIONS IN CORRELATING BURNOUT DATA
R. H. Wilson *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 45–62 refs (See N65-26812 16-33) CFSTI: $5.50

The results of graphical analysis of burnout data from uniformly heated channels, and a brief discussion of the comparison of correlations with data are presented. From the burnout data, it is concluded that uniform flux burnout data have been correlated for limited ranges of variables. For nonuniform fluxes the burnout location as well as the local burnout heat flux is a dependent variable. Burnout is a local effect but is related to system variables. Until dependable local condition predictions are available, progress can be made by studying the effect of system variables on burnout. N.E.A.

N65-26821 Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
FILM BOILING HEAT TRANSFER AT LOW QUALITY OR SUBCOOLED REGION
L. S. Tong *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 63 refs (See N65-26812 16-33) CFSTI: $5.50

The mechanism of film boiling at low quality or subcooled region are different from that at high qualities. The flow pattern

of film boiling at low quality was annular with liquid in the center and vapor film along the walls of the tube, whereas the flow pattern of film boiling at high qualities changed to one with liquid dispersed in the form of droplets through a predominant vapor flow. Similar results were reported previously that the film boiling heat transfer of a steam-water mixture at 1000 psia behaves differently at wall temperatures below or above 900° F. An engineering correlation (equation) for the film boiling heat transfer at low quality or subcooled region used at Westinghouse Atomic Power Division is given. N.E.A.

N65-26822 Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.

HOW TO PRESENT BURNOUT (OR DNB) DATA

L. S. Tong *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 65–72 refs (See N65-26812 16-33) CFSTI: $5.50

A practical method is shown for the presentation of burnout data using system parameters. Even though some parameters are believed by some investigators to have only a weak influence on the critical heat flux, a conclusive evidence in theory as well as in experiment is still required. It is suggested that all the independent parameters of a system be included in the boiling crisis data presentation. One may keep the weak parameters constant in testing or correlating but should still report their magnitude to avoid misunderstanding. Since all the independent parameters of a boiling channel are significant to a reactor design, the omission of any operational parameters in a critical heat flux correlation by certain approximate relationships may mislead the designer by a parameter distortion. N.E.A.

N65-26823 Hanford Atomic Products Operation, Richland, Wash.

BOILING BURNOUT WITH 19-ROD BUNDLES

J. Batch *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 73–77 (See N65-26812 16-33) CFSTI: $5.50

Boiling heat fluxes were determined for an electrically heated model of 19-rod bundle fuel elements using warts to maintain the 0.050-inch spacing between the rods. The experiments were performed to compare boiling burnout heat fluxes of test sections using wire wraps or using warts for rod spacing. Experimental data shows very little difference between the two. A total of 49 boiling burnout experiments were made with electrically heated models of a 19-rod bundle fuel element with a heated length 19-1/2 inches preceeded by an unheated length of 25 inches. Two test sections were used. Both test sections are described. Approximately two-thirds of the test runs were made with inlet conditions of from zero to about 30 per cent quality steam. The remainder of the runs had inlet conditions at various degrees of subcooling. Approximately half of the runs were continued to heat fluxes greater than those which gave the first indication of boiling burnout. Some conclusions drawn from these experiments are presented. N.E.A.

N65-26824 Centro Informazioni Studi Esperienze, Milan (Italy).

SOME RECENT DEVELOPMENTS OF THE STUDIES ON HEAT TRANSFER AND HYDRODYNAMICS IN TWO-PHASE FLOW UNDER WAY AT CISE

G. Peterlongo *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 79–87 refs (See N65-26812 16-33) CFSTI: $5.50

A summary of part of the work on heat transfer and hydrodynamics with steam–water mixtures in two-phase flow is presented. The experiments were performed in forced convection conditions, with steam–water mixtures flowing vertically upwards. Two open loops of different size were used. In both cases the test line is pressurized by means of a control valve discharging into the atmosphere without heat recovery. Heating is obtained by Joule effect by passing direct current through the metallic wall of the test section having the same cross-section geometry or by other inlet geometries, as mixers. The ranges of physical variables explored are given. A brief discussion is given on: (1) pressure drop in steam–water mixtures, round tubes, vertical upflow; (2) heat transfer to steam–water mixtures; (3) heat transfer crisis with steam–water mixtures; and (4) heat transfer crisis with steam–water mixtures in complex geometries. N.E.A.

N65-26826 General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

INVESTIGATION OF TRANSITION BOILING HEAT TRANSFER AT GENERAL ELECTRIC COMPANY

E. P. Quinn, J. E. Hench, and C. L. Swan *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 107–122 refs (See N65-26812 16-33) CFSTI: $5.50

Measurements of boiling water heat transfer behavior beyond the critical heat flux have been obtained for steam qualities above 25% for high pressure forced flows. Two test assemblies were employed: a two-rod cluster and a single rod in an annulus. Single rod observation include high speed motion pictures of flow patterns. Results of the single rod observations and the two-rod tests are given. N.E.A.

N65-26827 Argonne National Lab., Ill. Reactor Engineering Div.

THE BOILING LIQUID METAL PROGRAM AT ARGONNE NATIONAL LABORATORY

R. C. Brubaker, J. B. Heineman, R. E. Holtz, and R. P. Stein *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 125–137 (See N65-26812 16-33) CFSTI: $5.50

The Boiling Liquid Metal Program is designed to obtain experimental information pertinent to the boiling heat transfer and fluid flow behavior of the alkali metals. The program is divided into two separate experimental efforts, both involving measurements with sodium pumped around heated flow loops. The first, which will be operated shortly, will measure pressure and vapor volume fraction distributions in unheated test sections at boiling temperatures below 1600° F. The second, which is in design, concept testing, and equipment ordering stage, will be concerned with measurements in heated test sections at boiling temperatures up to 2100° F. A description of the design and a photograph of the 1600° F loop under construction are presented. Overall loop design, test section design, and preliminary experiments on electron bombardment heating are presented for the 2100° F loop. N.E.A

N65-26828 Brookhaven National Lab., Upton, N. Y.

SOME ANALYSES RELATED TO CONVECTIVE BOILING HEAT TRANSFER

J. C. Chen *In* AEC Proc. of the 2d Joint USAEC-EURATOM Two-Phase Flow Meeting Nov. 1964 p 139–152 refs (See N65-26812 16-33) CFSTI: $5.50

This note discusses analyses for (a) effective Reynolds numbers in two-phase flow, (b) effect of non-uniform temperature profile on bubble growth, and (c) boundary layer thickness in annular two-phase flow. These are relevant to considerations of convective boiling heat transfer, as presented in recent correlations. Author

N65-26829 Massachusetts Inst. of Tech., Cambridge.
HEAT TRANSFER DURING FILM CONDENSATION OF A LIQUID METAL VAPOR
W. M. Rohsenow *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 153–171 refs (See N65-26812 16-33) CFSTI: $5.50

This note discusses investigation to remove the discrepency between theory and experiment for the case of heat transfer during film condensation of liquid metal vapors. The general observation of all previous experimental investigation has been that the measured values of the heat transfer coefficient on the condensing side are much lower than the prediction from Nusselt's classical theory or from recent modifications to that theory. No explanation of the reasons for the discrepancy has so far been made. A review of the literature on the development of the technology and experimental investigations for liquid metals is given. Analytical considerations are given to the liquid-vapor interface, condensation coefficient, magnitude of the interface temperature drop, solid-liquid interface, and the effect of noncondensable gases. An experiment is presented on the condensing side heat transfer coefficient. The results and discussion are included. N.E.A.

N65-26830 Aerojet-General Nucleonics, San Ramon, Calif.
HEAT TRANSFER AND PRESSURE DROP FOR FORCED CONVECTION BOILING OF RUBIDIUM AND CESIUM
C. R. Fisher *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 173–194 refs (See N65-26812 16-33) CFSTI: $5.50

This paper presents the results of an experimental investigation of the heat transfer and pressure drop characteristics of boiling rubidium and cesium in forced convection. Nucleate boiling heat transfer data were obtained and are plotted in the form of heat flux versus temperature difference. Critical heat flux data are compared to a simple fog flow model. Two-phase pressure drop results are compared to a modified homogeneous flow model of Kutateladze and also to a correlation of Schrock and Grossman. Author

N65-26831 Oak Ridge National Lab., Tenn.
STUDIES IN BOILING WITH LIQUID POTASSIUM
H. W. Hoffman and A. I. Krakoviak *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 195–206 refs (See N65-26812 16-33) CFSTI: $5.50

The experimental program on the thermal and hydrodynamic characteristics of boiling alkali liquid metals has been continued without essential change in either scope or direction. While all aspects of the work are being pursued, this report is concerned only with those portions of these studies involving convective boiling with potassium. In the studies of convective boiling with liquid potassium inside of a vertical, circular tube, emphasis is placed on the determination of critical heat flux values. An experiment providing for a quantitative measure of the liquid superheat associated with boiling potassium was devised. A discussion of this experiment is presented. N.E.A.

N65-26833 Compagnie Francaise Thomson-Houston, Paris (France).
THE VAPOTRON
C. Beurtheuret *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 213–216 (See N65-26812 16-33) CFSTI: $5.50

The vapotron is a device that have the ability to supress the critical point of the Nukiyama curve and to shift the ebullition crisis and calefaction process to a high level of flux density. This very particular behaviour is due to an effect of cross-stabilization of the transition boiling and of a continuous gradient of temperature along an extended area of heat transfer. The existence of this process is under the dependence of some individual dimensions in the network of local extensions of the wall surface. A film is discussed that shows the typical aspects of the complex boiling and the perfect stability of the vapotron process. The present state of the art of the vapotron process is presented. N.E.A.

N65-26834 Atlantic Research Corp., Alexandria, Va.
STUDIES OF BOILING HEAT TRANSFER WITH ELECTRICAL FIELDS
Michael Markels, Jr. and Robert L. Durfee *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 217–252 refs (See N65-26812 16-33) CFSTI: $5.50

Alternating current voltage (60 cps) was found to increase boiling heat transfer rates and prevent film boiling for deionized water under forced convection at essentially ambient pressure. Steam was used to supply heat to the interior wall of an annulus, and voltages up to 5,000 volts were impressed across the region of vapor formation. The highest heat transfer rates reached were approximately twice the normal nucleate boiling peak. No effects of mass flow rate up to 5.2×10^5 lb/hr-sq. ft. or of exit quality up to about four per cent by weight vapor on the heat transfer increase by voltage application were observed. Data obtained from tests in which the external wall of the flow annulus was heated indicated an increase in heat flux up to 2,000 volts, followed by a decrease in heat flux at voltages above 2,000 volts. Author

N65-26835 Oak Ridge National Lab., Tenn.
RECENT STUDIES OF BOILING BURNOUT
W. R. Gambill *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 253–271 refs (See N65-26812 16-33) CFSTI: $5.50

Five recent investigations of the critical heat flux in water systems are described: (1) inherent uncertainty in the critical heat flux; (2) heat transfer inside of horizontal, open ended heated tubes immersed in a pool; (3) natural-convection burnout of closed vertical channels; (4) subcooled boiling and burnout with heated twisted tapes; and (5) swirl-flow forced-convection bulk-boiling loop. N.E.A.

N65-26837 Geoscience Ltd., La Jolla, Calif.
REVIEW OF THE GEOSCIENCE BOILING LIQUID-METALS RESEARCH PROGRAM
H. F. Poppendiek *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 281–296 refs (See N65-26812 16-33) CFSTI: $5.50

Geoscience Ltd. has been investigating the influence of helical flow on heat transfer and fluid flow in liquid metal, forced-flow boiling. Analytical and experimental studies are being conducted. Mercury has been examined and potassium is currently under study. Some of the experimental results and corresponding analytical interpretations of the Geoscience liquid-metal research are presented on droplet vaporization at a boiler tube wall, fog flow, single-phase flow, and forced-flow boiling mercury. N.E.A.

N65-26838 Commissariat a L'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
STUDY ON FLOW OSCILLATION IN A BOILING CHANNEL
J. Villeneuve *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 299–309 (See N65-26812 16-33) CFSTI: $5.50

In a study on flow oscillation in a boiling channel, results are presented showing the variation of oscillation thresholds

versus specific power, inlet subcooling, total head of the channel length raiser, and friction in the single phase region near the inlet. Some experimental results of instabilities thresholds are shown. A theoretical search and calculations are being made to try to understand what are the principal parameters of the system controlling instability. A mechanism is supposed to explain the phenomenon. This mechanism is written as simply as possible (writing a model) and the model is introduced in the classical equations (continuity, momentum, energy, and state). If the results are in the same order of magnitude as the experimental results, the calculations are complicated tc approached to the experimental conditions. It is assumed that the system is in thermodynamic equilibrium. Three models are presently being worked on: the first one is based on time lag effect, another model assumes that the fluid is one phase but with the specific mass varying rapidly with enthalpy—that is, a density effect, and the third model assumes that the instability comes from a variation of friction of connection with a change in flow pattern. N.E.A.

N65-26840 Technische Hogeschool, Eindhoven (Netherlands).
SOME RESULTS OF MEASUREMENTS IN STEADY AND NON-STEADY STATE IN AN ANNULAR GEOMETRY OBTAINED IN THE TWO-PHASE FLOW PROGRAM OF THE LABORATORY FOR HEAT TRANSFER AND REACTOR ENGINEERING OF THE TECHNOLOGICAL UNIVERSITY OF EINDHOVEN
M. Bogaardt and C. L. Spigt *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 317–336 refs (See N65-26812 16-33) CFSTI: $5.50

Some results of an experimental study of the characteristics in steady states and the onset of instabilities in a vertical boiling channel with natural convection are presented. An attempt is made to define a suitable criterion for the onset of instabilities using auto-correlations and power density curves. The character of the instabilities is studied by means of a multistage impedance void detector. The onset of instabilities is presented as a function of pressure and subcooling. Preliminary results are shown of the measurement of the transfer function from power to void. Author

N65-26841 General Electric Co., Schenectady, N. Y. Advanced Technology Labs.
A PROGRAM OF TWO-PHASE FLOW INVESTIGATION WITH HEAT ADDITION
F.W. Staub and N. Zuber *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 337–364 refs (See N65-26812 16-33) CFSTI: $5.50

Research efforts are reported on a program designed to gain an understanding of the various phenomena which lead to thermal-hydraulic oscillation in forced convection two-phase flow systems with heat addition and, to obtain equations and criteria which can be used for predicting the inceptions of these oscillations and instabilities as function of input parameters and system characteristics. Items completed during the first year of the contract are listed. A brief summary of the primary characteristics of the test loop and test sections, as well as an outline of the analytical work is presented. N.E.A.

N65-26842 Argonne National Lab., Ill. Reactor Engineering Div.
FOG FLOW MODELS
Ralph P. Stein *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 367–385 refs (See N65-26812 16-33) CFSTI: $5.50

A simple physical model of a fog flow (the flow of a single component vapor–liquid mixture in which the liquid exists as fine droplets carried along with the vapor flow) was developed which appeared to be able to explain some of the measurements of phase distribution in nonheated ducts as well as the occurrence of critical heat transfer condition, when the fluid enters the duct as a vapor–liquid mixture. The model is a mathematical formulation. Extensions and evaluations of this formulation are part of the present research effort. A general description of the model as developed is given as well as details of one extension presently being explored and mention of a second extension for possible future consideration. N.E.A.

N65-26843 Aerojet-General Corp., Azusa, Calif.
THEORETICAL PRESSURE AND PHASE DISTRIBUTIONS IN TWO-PHASE FLOW
J. O. Bradfute *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 387–389 refs (See N65-26812 16-33) CFSTI: $5.50

In order to predict the longitudinal distribution of pressure, temperature, quality, and void fraction in a heated channel or the electrically heated test section in a boiling heat transfer experimental loop, six basic equations were written which simultaneously represent the two-phase system as it is envisioned. This set of equations currently is being programed for machine solution. A description of some of the equations and the bases on which they were derived are presented. The equations described provide adequate information on the thermodynamic and hydrodynamic behavior of a two-phase flow to obtain information on pressure drop as well as the relationship between quality and void fraction. The equations are intended to give a microscopic description of the two-phase flow for both heated and nonheated cases. N.E.A.

N65-26851 Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
VOID FRACTION MODELS IN SUBCOOLED BOILING
J. Villeneuve *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Meeting Nov. 1964 p 489–497 refs (See N65-26812 16-33) CFSTI: $5.50

Two void fraction models are used to give, with very simple formula, a fairly good approximation of experimental results for high pressures. By using these models, data of pressure drop in subcooled boiling without any discontinuity in the friction factor at the zero thermodynamic quality are correlated. An illustration of the results is given. N.E.A.

N65-26852 North Carolina State Coll., Raleigh.
A STUDY OF CONVECTION BOILING INSIDE CHANNELS
J. K. Ferrell *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 499–506 (See N65-26812 16-33) CFSTI: $5.50

Experimental and theoretical studies on two-phase, single component fractional pressure losses in uniformly heated channels are carried out. The emphasis is on two-phase flow with boiling at heat fluxes typical of nuclear reactor operation. The experimental approach is the simultaneous measurement of all important parameters. In the investigation an experimental run consists of the measurement of the total pressure drop and steam volume fraction along the test section for constant system pressure, flow rate, inlet temperature, and heat flux. From these data it is desired to deduce the pressure drop due to friction as a function of position, or as a function of quality. The procedure for this data reduction is given. N.E.A.

N65-26854 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESEARCH EFFORTS ON BOILING AND TWO-PHASE FLOW IN THE CRYOGENIC HEAT TRANSFER SECTION OF NASA LEWIS RESEARCH CENTER

Y. Y. Hsu and R. W. Graham *In* AEC Proc. of the 2d Joint USAEC–EURATOM Two-Phase Flow Meeting Nov. 1964 p 529–531 (See N65-26812 16-33) CFSTI: $5.50

Current efforts on the study of boiling and two-phase flow in this group can be divided into four broad areas: mechanism of boiling heat transfer, mechanism of the two-phase flow, studies of heat transfer by cryogenic fluids in the subcritical and super-critical states, and the effect of various body forces on boiling and two-phase flow. A brief description of projects in each of the areas is presented. N.E.A.

N65-26855*# National Aeronautics and Space Administration, Washington, D. C.
SYMPOSIUM ON THERMAL RADIATION OF SOLIDS
S. Katzoff, ed. 1965 590 p refs Symp. held at San Francisco, 4–6 Mar. 1964; sponsored by AF, Natl. Bur. of Std., and NASA (NASA-SP-55; ML-TDR-64-159) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

Thermal radiation of solids symposium papers are presented covering the following topics: fundamentals, surface effects, measurement techniques, space environmental effects, and applications. For individual titles see N65-26856–N65-26911.

N65-26856* Little (Arthur D.), Inc., Cambridge, Mass.
A REVIEW OF SOME PROBLEM AREAS IN THE THEORY OF THERMAL RADIATION OF SOLIDS
A. G. Emslie *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 3–9 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

This paper gives a discussion of three problem areas in the field of thermal radiation of solids. The most basic problem is the calculation, from first principles, of the optical constants *n* and *k* of homogeneous materials such as metals and dielectrics. If this can be accomplished, all the radiation properties of materials with smooth surfaces can be evaluated by known methods. Another general problem area, involving statistical considerations, includes theories of the radiation characteristics of rough surfaces, of inhomogeneous materials such as powders, and of composite materials such as multiple radiation shields with insulating spacers. The highly nonisotropic thermal properties of such radiation shields cause great difficulties in connection with joints and penetrations. Closely spaced solid objects, as in powders and shields, may involve unusual radiation transfer due to near-field interaction. The third type of theoretical problem is one of computational complexity rather than of principle and has to do with radiation and conduction interchange on a macroscopic scale in complex structures such as space vehicles. When the structure contains many specularly reflecting surfaces the problem is beyond the power of present techniques. Author

N65-26861* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
THE THEORY OF EMISSIVITY OF METALS
Klaus Schocken and Neil Ashby (P. E. C. Res. Associates) *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 63–71 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

It is shown that practical situations exist in which the emissivity of a surface is not equal to the absorptivity. The calculations which reveal this fact are based on a second-quantized treatment of the electromagnetic radiation field. To account for the high reflectivity of metals, it is necessary to use a set of basis functions for the radiation field which are exponentially attenuated (but without net absorption) within the metal. On this basis, a perturbation theory formalism is developed with which the emissivity may be calculated as a function of wavelength, angle of emission, polarization, and temperature, whenever the electronic wave functions are known. Author

N65-26862* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
RADIATION HEAT TRANSFER THROUGH SCATTERING AND ABSORBING NONISOTHERMAL LAYERS
Jonathan D. Klein *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 73–81 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75
(Contracts AT(30-1)-1852; AF 33(616)-8368)

Steady-state radiation heat transfer through layers where both scattering and absorption occur within the layers is treated analytically by means of one-dimensional fluxes. The set of simultaneous equations—consisting of a heat-balance equation, an equation for the flux in the direction of heat flow, and an equation for the flux in the opposite direction—has a general solution to which boundary conditions are applied to derive expressions for desired quantities for an arbitrary layer. In this way the transfer through a layer and the emission from it, as well as its temperature distribution, are derived in terms of the absorption and scattering coefficients of the layer, the index of refraction, the lattice conductivity, and the heat applied to it. The treatment includes the effects of surface reflections. Radiation transfer through nonradiating layers is also treated in order to provide equations for obtaining the absorption and scattering coefficients from optical transmission measurements. Author

N65-26863* Ling-Temco-Vought, Inc., Dallas, Tex. Astronautics Div.
FUNDAMENTALS OF THERMAL RADIATION IN CERAMIC MATERIALS
R. L. Cox *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 83–101 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

The thermal radiative properties of ceramics that depend on intrinsic optical constants and microstructure are discussed. Surface reflections and volume emission in optically smooth homogeneous materials are first reviewed. Scattering and absorption in heterogeneous materials are then considered, and a correlation is drawn between coefficients predicted from single-particle theory and those utilized by the radiative-transfer equations. The proper inclusion of surface reflections in the radiative transfer equations is discussed, and surface roughness effects in general are examined. Author

N65-26864* Minnesota Univ., Minneapolis. Heat Transfer Lab.
RADIANT EMISSION, ABSORPTION, AND TRANSMISSION CHARACTERISTICS OF CAVITIES AND PASSAGES
E. M. Sparrow *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 103–115 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

A systematic study is made of the emission and absorption of thermal radiation by cavities and of the transport of thermal radiation through passages. The conditions under which cavity absorption characteristics can be inferred from cavity emission characteristics (and vice versa) are derived. In particular, it is shown that this reciprocity is valid when the radiation entering the cavity is diffusely distributed across the cavity opening. It is demonstrated, for example, that the absorption-emission characteristics of cylindrical-hole cavities and rectangular-groove cavities are essentially identical. Specularly reflecting cavities are found to be more efficient

emitters of radiant energy than are diffusely reflecting cavities; this statement also applies to the absorption of diffusely distributed incoming radiation. The transport of thermal radiation through passages which connect isothermal environments is analyzed for both specularly reflecting and diffusely reflecting passage walls. Results are presented for the radiant transport through tapered tubes and tapered (plane-wall) gaps. Author

N65-26865* National Bureau of Standards, Washington, D. C.
A TEST OF ANALYTICAL EXPRESSIONS FOR THE THERMAL EMITTANCE OF SHALLOW CYLINDRICAL CAVITIES
Francis J. Kelly and Dwight G. Moore *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 117–131 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

Analytical expressions for the (approximately axial) thermal emittance of a shallow cylindrical cavity were tested by means of room-temperature reflectance measurements. The measurements were made by placing a paper-lined brass cavity of adjustable depth over the specimen opening of a recording spectrophotometer. Reflectance curves were obtained from 0.40 to 0.75μ with the plunger positioned to give cavity depth-to-radius ratios of 0, 0.5, 1.0, 1.5, and 2.0. The resulting reflectances were then converted to emittances through use of the relation that, for an opaque material, the emittance is equal to one minus the reflectance. Two theoretical expressions predicted the emittance of a cavity with a diffusely reflecting wall to within 0.01. A closed-form expression of Gouffé, which forms the basis of a shallow-hole method for measuring the emittance of nonmetals at high temperatures, was in as good agreement with the experimental measurements as a more rigorous expression derived by a different approach. A specular component in the reflecting behavior of the cavity wall material for light incident at large angles from the normal had a negligible effect on the cavity emittance at a depth-to-radius ratio of 0.5, but its effect became important as the cavity depth was increased. Author

N65-26866* Lockheed Missiles and Space Co. Palo Alto, Calif.
A GENERALIZED PHYSICAL MODEL OF THE ROLE OF SURFACE EFFECTS IN MODIFYING INTRINSIC THERMAL RADIATION PARAMETERS
Roger E. Gaumer *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 135–139 (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

As a basis for discussing thermal radiation characteristics, physical phenomenological models of metallic and dielectric material surfaces are presented. The role and significance of surface topography, of contaminant surface films and infused impurities, and of pore size and separation in dielectrics are reviewed; and the desirability of adequately specifying surfaces is emphasized. Author

N65-26870* National Bureau of Standards, Washington, D. C.
IMPORTANCE OF SURFACE FILMS
Joseph C. Richmond *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 157–158 ref (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 22C

The effects of surface conditions, such as roughness and the presence of films, on thermal radiation properties are briefly outlined, and an example is cited where oxide films formed on heating in a good laboratory vacuum (about 10^{-5} torr) markedly affected the total hemispherical emittance of a specimen of sandblasted Inconel. Author

N65-26873* National Bureau of Standards, Washington, D. C.
SURFACE TEXTURE MEASUREMENTS OF METAL SURFACES
D. B. Spangenberg, A. G. Strang, and J. L. Chamberlin *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 169–177 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

Surface-texture measurements made on samples of hand-polished sintered beryllium, gage block tool steel finished by a lapping process, and commercially finished gage block steel, are presented. Several conventional parameters describing these surfaces were determined by stylus and interferometric techniques. Interferograms of the surfaces are included in this report. J.M.D

N65-26874* Honeywell, Inc., Minneapolis, Minn. Research Center.
THE MEASUREMENT OF TOTAL SURFACE AREA
J. E. Janssen and R. N. Schmidt *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 179–181 refs (See N65-26955 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

If the geometry of a surface could be adequately described it might be possible to publish radiation properties for smooth surfaces and calculate the effect of variations in surface roughness. A method employing a radioisotope tracer technique for measuring total surface area is described. A monomolecular layer of carbon-14 tagged surficant is employed. It appears that a knowledge of the total surface area along with profilometer measurements might provide sufficient data to construct a reasonably accurate model of the surface. Author

N65-26875* Naval Radiological Defense Lab., San Francisco, Calif.
THE TIME VARIATION OF THE TOTAL HEMISPHERICAL EMITTANCE OF POLISHED PLATINUM SURFACES AT HIGH TEMPERATURES
N. J. Alvares *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 183–187 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

Platinum strips were maintained at temperatures up to 1700° K for extended periods, during which repeated measurements of total emittance were made, together with photomicrographs of the surface. The photomicrographs show the gradual appearance and increasing definition of crystal grain boundaries during the extended heating. The simultaneous increase in emittance was very slight. A small decrease of emittance during the first few minutes is ascribed to a thermal-polishing mechanism. Author

N65-26876* Army Engineer Research and Development Labs., Fort Belvoir, Va.
SOLAR ABSORPTANCE AND THERMAL EMITTANCE OF EVAPORATED METAL FILMS WITH AND WITHOUT SURFACE COATINGS
Georg Hass *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 189–195 (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

This paper describes and discusses the techniques used in preparing thin evaporated metal films with and without superimposed dielectric coatings. In particular, the effects of evaporation rate and of oxygen pressure on the characteristics of silicon oxide films are reviewed. Theoretical angular reflectance characteristics of metals, as determined by the optical constants, are also reviewed. Author

N65-26877* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFECTS OF SURFACES ON THE INTRINSIC RADIATION PROPERTIES OF DIELECTRICS
Jonathan D. Klein *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 197–203 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

The effects of both external and internal surfaces on the radiation properties of dielectrics are discussed. External surfaces affect the emitted and transmitted radiation while internal surfaces (scattering centers) affect the heat transferred by radiation in addition. Gradient changes at surfaces due to changes in optical properties, and gradients in optically thin layers are also discussed. Author

N65-26879* Boeing Co., Seattle, Wash.
COMMENT ON MEASUREMENT TECHNIQUES
Willson A. Clayton *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 213–215 (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

A table summarizing the technology of measuring thermal radiation properties is presented and existing inadequacies, particularly with regard to nonopaque materials and angular dependence are pointed out. It is urged that standard measurement techniques with broad applicability be developed and established. Author

N65-26882* National Bureau of Standards, Washington, D. C.
METHOD AND EQUIPMENT FOR MEASURING THERMAL EMITTANCE OF CERAMIC OXIDES FROM 1200° TO 1800°K
Howard E. Clark and Dwight G. Moore *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 241–257 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

A description is given of the rotating cylinder equipment for measuring the total normal emittance and normal spectral emittance from 1 to 15μ of nonmetals as well as metals over the temperature range 1200° to 1800° K. Preliminary data are presented for 11 different ceramic oxide specimens at 1200° K and for platinum at 1400° K. A comparison is made between these data and emittance values obtained by measuring room-temperature spectral reflectance from 0.26 to 2.10μ for 6 of the 11 ceramic oxides. Possible sources of error are discussed. Author

N65-26883* National Aeronautics and Space Administration. Langley Research Center, Langley, Station, Va.
HEMISPHERICAL SPECTRAL EMITTANCE OF ABLATION CHARS, CARBON, AND ZIRCONIA (TO 3700°K)
R. Gale Wilson *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 259–275 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MC $2.75 CSCL 20M

The initial results of the application of special optical techniques to high-temperature emittance and reflectance studies of an ablation-material char and certain other refractory materials representative of those present in ablation residues formed during aerospace reentry operations are presented. Spectral hemispherical emittance and reflectance were determined with an image pyrometer integrated with an arc-imaging furnace for carbon, graphite, zirconia, and a phenolic-nylon ablation-material char at wavelengths from 0.37μ to 0.72μ for temperatures from 2100° K to 3700° K. The data obtained are compared with those of other investigations. Surface-roughness properties of the materials studied were determined from measurements made with a light-section microscope. The dependence of the spectral hemispherical emittance of oxidized carbon at a wavelength of 0.65μ on its surface-roughness properties was investigated experimentally, and the emittance was found to be a linear function of the root-mean-square slope of the surface when the roughness is large compared with wavelength. Author

N65-26884* AVCO Corp., Wilmington, Mass.
EMITTANCE MEASUREMENTS OF SOLIDS ABOVE 2000°C
T. S. Laszlo, R. E. Gannon, and P. J. Sheehan *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 277–286 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 (Contract AF 49(638)-1166) CSCL 20M

A method of measuring the emittance of solids above 2000° C through the use of a solar furnace has been developed. Two techniques, involving specialized instrumentation, for performing the necessary measurements were investigated. Initial experiments showed that both techniques were suitable and that the specified instruments were adaptable for making the required measurements. Author

N65-26885* National Bureau of Standards, Washinton, D. C.
PRELIMINARY STUDIES TOWARD THE DETERMINATION OF SPECTRAL ABSORPTION COEFFICIENTS OF HOMOGENEOUS DIELECTRIC MATERIALS IN THE INFRARED AT ELEVATED TEMPERATURES
W. Fussell and Ralph Stair *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 287–292 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

A preliminary determination of the spectral absorption coefficient of potassium bromide was made by measuring the spectral radiance ratios of two samples with different thicknesses mounted against a specular metal surface. The theory of the method, the apparatus used, and the experimental results are described. Author

N65-26886* Lockheed Missiles and Space Co., Palo Alto, Calif.
DIRECTIONAL SOLAR ABSORPTANCE MEASUREMENTS
N. J. Douglas *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 293–301 refs (See N65-26855 diation of Solids 1965 p 293–301 refs (See N65-26855-33) 16-33 GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

A method is presented for determining the solar absorptance of thermal control surfaces as a function of angle of incidence from a knowledge of both the ratio of solar absorptance to the thermal emittance (α_s/ϵ) and the emittance alone. A device which measures (α_s/ϵ) and ϵ of a test disk suspended within an evacuated black cryogenic environment and irradiated by a solar simulator is described. Solar absorptance measurements for incidence angles up to 85° can be accomplished with an uncertainty in the order of 4 to 8 percent. The results associated with directional solar absorptance measurements in the room temperature region for a Mylar-aluminum laminate sample are reported. Author

N65-26887* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A THERMAL VACUUM TECHNIQUE FOR MEASURING SOLAR ABSORPTANCE OF SATELLITE COATINGS AS A FUNCTION OF ANGLE OF INCIDENCE
Marla G. Hoke *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 303–312 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

An experimental technique for measuring the solar absorptance of a satellite coating as a function of angle of incidence

has been developed. A thermal vacuum method is used to measure the equilibrium temperature of a coated sample that may be turned so that it makes any desired angle to the incident beam. The sample is turned by means of a rotational apparatus installed in the vacuum chamber. Preliminary measurements of the directional solar absorptance of the following materials have been made: evaporated aluminum, evaporated gold, aluminum leafing paint, zinc sulfide paint, and Parson's black paint. The hemispherical solar absorptance of evaporated aluminum is calculated. Author

N65-26888* General Dynamics/Astronautics, San Diego, Calif.
THE DIRECTIONAL SPECTRAL EMITTANCE OF SURFACES BETWEEN 200° AND 600°C
W. M. Brandenberg and O. W. Clausen *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 313–320 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

An apparatus is described for making emittance measurements of flat samples at angles of emission between 15° and 80°, temperatures between 200° and 600°C, and wavelengths between 1 and 25 μ. The samples are placed in a vacuum of approximately 5×10^{-6} mm Hg and are surrounded by a liquid-nitrogen cooled wall to eliminate the effects of extraneous heat sources. For a platinum mirror the angular dependence of the emissivity is compared to that given by the Fresnel equation. Also, the angular dependence of a grooved surface with a black base and highly reflecting side walls was measured and compared to theory. Finally the normal emittance of a black paint as a function of wavelength and temperature was determined. Author

N65-26889* Boeing Co., Seattle, Wash.
MEASUREMENT OF EMITTANCE OF ORGANIC MATERIALS (ELECTRIC WIRE INSULATION)
George W. Mc Intyre *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 321–324 ref (See N65-26855 16-33) GPO: HC $3.75 CFSTI: MF $2.75 CSCL 20M

An apparatus and procedure are described for measuring the emittances of organic (or other low-conductance) materials. The method maintains a small sheet of the test material near room temperature by means of a water bath and measures the power input to an adjacent constant-temperature blackbody radiator that radiates only to the test specimen. Author

N65-26890* Naval Radiological Defense Lab., San Francisco, Calif.
LOW-TEMPERATURE CONDUCTIVE LOSSES IN EMITTANCE MEASUREMENTS BY THE DELAY METHOD
O. Makarounis *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 325–330 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

An analysis of the heat conductive losses along the supporting wires of a specimen and of the air conductive losses in a low-temperature evacuated chamber is presented. Conductive loss corrections for total hemispherical emittance measurements by the decay method, in the temperature range −150°C to 450°C, are also shown. Author

N65-26891* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE APPLICATION OF TEMPERATURE RATE MEASUREMENTS TO THE DETERMINATION OF THERMAL EMITTANCES
William M. Hall *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 331–336 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

Two calorimetric techniques have been evolved to facilitate accurate measurements of room-temperature hemispherical emittance of spacecraft temperature control surfaces in a reasonably short period of time, without the use of high-precision temperature-control apparatus. One technique makes use of data from several arbitrarily induced heating and cooling curves in an iteration procedure which converges within a 3-hour observation period to a steady-state power-temperature set of values. The other technique uses a heating curve and cooling curve to calculate emittance without the use of the sample heat capacity value. The results are compared with emittances obtained from long-term temperature equilibrium tests for several surfaces of low and medium emittance. Data are given to indicate the accuracy and dispersion of such measurements. Measurements were made on heated 6- by 6-inch flat samples placed adjacent and parallel to a liquid-nitrogen-cooled flat receiver plate which viewed the sample hemispherically. Author

N65-26892* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROBLEMS AND RESEARCH EFFORT IN SPACE ENVIRONMENT EFFECTS
Gerhard B. Heller *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 339–343 (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

A very brief review is given of the problem of thermal control of spacecraft and of the problem of the stability of thermal control surfaces to the particle radiation, solar ultraviolet radiation, and micrometeoroids in space. The different aspects of the environment effect problem that are treated by the papers in this session are indicated. Curves are presented showing equilibrium temperatures of cylindrical spacecraft at distances from the Sun of 0.1 astronomical unit to 30 astronomical units (orbit of Neptune) for α_s/ϵ_T values up to 10. Author

N65-26894* Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.
SOME FUNDAMENTAL ASPECTS OF NUCLEAR RADIATION EFFECTS IN SPACECRAFT THERMAL CONTROL MATERIALS
J. E. Gilligan and R. P. Caren *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 351–364 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M (Contract AF 04(695)-136)

The methods and results of an investigation to determine the mechanisms by which solar reflector thermal control systems degrade under individual and combined ultraviolet and nuclear radiations are described. Appropriate optical- and radiation-effects theories are compared with the published results of irradiation experiments in which certain transparent dielectric and semiconductor pigments have been studied. Conclusions are reached regarding the equivalence of ultraviolet- and nuclear-radiation effects, basic mechanisms of induced reflectance changes, and possible means of limiting the degradation caused by these radiations. Author

N65-26895* Lockheed Missiles and Space Co., Palo Alto, Calif.
NUCLEAR ENVIRONMENTAL EFFECTS ON SPACECRAFT THERMAL CONTROL COATINGS
R. A. Breuch and H. E. Pollard *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 365–379 ref (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 (Contract AF 04(695)-136) CSCL 22M

A total of 250 different standard, developmental, and research thermal-control coatings have been irradiated in vacuum

with a nominal integrated dose of 10^{10} ergs-g(C) gamma and 10^{14} fast neutrons/cm^2. This paper presents a preliminary summary of the effects of nuclear radiation on the optical properties of some selected coating materials. The materials include inorganic (silicate bonded) systems, plasma-sprayed ceramic coatings, chemically polished metals, acrylic- and epoxy-base coatings, silicone dispersion systems (air-cured), and adhesive-applied silicone films. Optical properties before and after irradiation are given. Also presented are plots of total hemispherical emittance measured during irradiation. Effects of accelerated simultaneous nuclear and ultraviolet irradiation on solar-reflector coatings and the effects of sample temperature during irradiation are included. Author

N65-26896* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DEVELOPMENT OF A TECHNIQUE FOR THE CORRELATION OF FLIGHT- AND GROUND-BASED STUDIES OF THE ULTRAVIOLET DEGRADATION OF POLYMER FILMS

John A. Parker, Carr B. Neel, and Morton A. Golub (Stanford Res. Inst.) *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 381–389 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

Films of both polymers and copolymers of vinyl chloride were exposed to ultraviolet radiation in vacuum and were found to exhibit a regular and quantitatively measurable change in solar absorptance with time. The major changes produced by this exposure occurred in the ultraviolet and visible regions. Virtually no change has been observed in the infrared absorption spectra of these films, even after exposure to the equivalent of 72 hours of space solar radiation. To obtain the desired mechanical properties for a flight test, a surface consisting of a pure polyvinyl chloride terpolymer film (VMCH) was cast on a polished aluminum substrate. This material is found to behave almost identically to the pure polyvinyl chloride. Predicted temperature changes of such a surface will be compared with the results obtained on this surface in actual orbital flight of OSO-C. The amount of gamma radiation required to produce a given change in the absorptance equivalent to that produced by a specific amount of ultraviolet radiation has also been determined experimentally. The gamma radiation which would produce the same effect as 30-hour exposure to the solar ultraviolet would require a period of several years of exposure in space, and, hence, would not influence the results of the correlation of the ultraviolet exposure. Author

N65-26897* IIT Research Inst., Chicago, Ill.

ULTRAVIOLET IRRADIATION OF WHITE SPACECRAFT COATINGS IN VACUUM

G. A. Zerlaut, Y. Harada, and E. H. Tompkins *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 391–420 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75

(Contracts NAS7-100; JPL-950111) CSCL 20M

Investigations of stability of materials to simulated space conditions were conducted in conjunction with a developmental program of spacecraft thermal control coatings. Determination of spectral reflectance and solar absorptance before and after exposure showed that none of the materials studied is completely unaffected by ultraviolet irradiation in vacuum. However, zinc oxide and, to a lesser extent, zinc sulfide were found to be unusually stable white pigments and formed relatively stable coatings when dispersed in pure potassium silicate or in experimental methyl silicone polymers. Exposure to 4200 equivalent sun-hours of ultraviolet radiation in vacuum resulted in solar absorptance increases of less than 0.02 for both an experimental silicone and a potassium silicate paint pigmented with zinc oxide. Author

N65-26898* Lockheed Missiles and Space Co., Palo Alto, Calif.

THE EFFECTS OF ULTRAVIOLET RADIATION ON LOW α s/ϵ SURFACES

R. L. Olson, L. A. McKellar, and J. V. Stewart *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 421–432 refs (See N65-26855 16-33) GPO: HC $3.75 CFSTI: MF $2.75 CSCL 20M

A primary source of natural environmental damage to spacecraft thermal-control surfaces is solar ultraviolet energy. An experimental investigation of this damage is described. The primary purposes of this work are (1) the evaluation of candidate materials and (2) the prediction of operational behavior for selected materials. Candidate surfaces are exposed in vacuum to near-ultraviolet energy; the effect of these exposures on the materials' normal spectral reflectance is determined. The primary energy source is the A-H6 mercury-argon high-pressure lamp; this is used bare and with filters. Incident fluxes are determined with calibrated phototubes and with thermopiles. Sample ambient pressures are maintained at 10^{-6} to 10^{-7} torr; sample temperatures are varied from 70° F to 500° F. Incident flux densities are varied tenfold. Both initial damage and damage reversibility (bleaching) are investigated. Efforts are concentrated on white pigment-vehicle binary systems which are candidate low α_s/ϵ spacecraft surfaces. Results demonstrate the dependence of damage upon wavelength of irradiation and upon sample temperature. Materials studied include silicate, silicone, acrylic, and epoxy vehicles, and titania, zinc oxide, zirconium silicate, and lithium-aluminum-silicate pigments. Author

N65-26899* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A STUDY OF THE PHOTODEGRATION OF SELECTED THERMAL-CONTROL SURFACES

George Pezdirtz and Robert A. Jewell *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 433–441 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

Ultraviolet Stability of Thermal-Control Coatings are presented, as well as some recent studies of the ultraviolet stability of a chemical conversion coating (Alodine 401). A preliminary study of the effects of gamma radiation from cobalt-60 on solar absorptance (α) of several selected white paint-type coatings has shown that the high-energy radiation (electrons and protons) in space can be expected to increase the solar absorptance, but at a slower rate than the ultraviolet radiation from the Sun.

Author

N65-26900* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PRELIMINARY RESULTS FROM A ROUND-ROBIN STUDY OF ULTRAVIOLET DEGRADATION OF SPACECRAFT THERMAL-CONTROL COATING

J. C. Arvesen, C. B. Neel, and C. C. Shaw *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 443–452 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

Study is being conducted on identical samples of four low-solar-absorptance white coatings: rutile titanium dioxide/epoxy, rutile titanium dioxide/silicone, antimony trioxide/potassium silicate, and zinc oxide/potassium silicate. Results show considerable variance; however, initial correlations have been attempted on the basis of temperature, pressure, and the intensity and spectral distribution of the source. Results indicate the need for more accurate measurement of thermal radiation properties, improvements in existing environmental simulation capabilities, and a greater understanding of the chemical processes associated with ultraviolet degradation of thermal-control coatings. Author

N65-26901* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE EFFECTS OF MICROMETEOROIDS ON THE EMITTANCE OF SOLIDS
Ronald B. Merrill *In* NASA, Washington Symp. on Thermal Radiation of Solids 196b p 453–472 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

An analytical model is developed to predict the change in the emittance of a surface caused by particle impact. This model is applied in a representative fashion to determine the change in the emittance due to the space environment. Theoretical results are compared with experimental results. Author

N65-26903* Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
HIGH-TEMPERATURE THERMAL OPTICAL PROPERTY ACTIVITIES OF THE
Donald F. Stevison and Merrill L. Minges *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 485–494 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

High temperature thermal optical property studies along with a brief discussion of the important physical mechanisms involved in absorption and emission of radiation within solids is given. The basic experimental and instrumentation problems associated with accurate thermal optical property determinations at high temperatures are considered. Efforts are reviewed in the areas of measurement technique developments, analysis of radiative transport phenomena in opaque and semitransparent materials, and new materials developments where radiative characteristics are important. Author

N65-26904* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AREAS OR RESEARCH ON SURFACES FOR THERMAL CONTROL
William Snoddy and Edgar Miller *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 495–507 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

Representative current literature was reviewed to determine the state of the art with respect to availability of thermal control surfaces in general, and specifically when certain constraints are imposed. A discussion of the results is given along with tables and graphs. Also discussed briefly are the individual types of coatings that would be desirable for passive thermal control of space vehicles. It is hoped that this paper makes evident some of the many areas of research on thermal control surfaces in which new or additional efforts might yield greatly needed results. Author

N65-26905* Honeywell, Inc., Hopkins, Minn. Research Center.
SELECTIVE COATINGS FOR VACUUM-STABLE HIGH-TEMPERATURE SOLAR ABSORBERS
R. N. Schmidt and J. E. Janssen *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 509–524 refs (See N65-26855-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

One of the necessary design criteria for a solar thermal-cycle power system aboard a spacecraft is the thermal radiation properties of the surface on which the solar energy is absorbed. A coating which selectively absorbs solar energy but does not radiate infrared energy gives increased absorber efficiency over a nonselective blackbody at lower solar flux concentrations and higher temperatures. An interference coating consisting of multiple layers of alumina and molybdenum on a molybdenum substrate gave a solar absorptance of 0.83 and an emittance of 0.11 at 1000° F. A selective black surface, beryllium plus 1 percent copper alloy anodized in sodium hydroxide, produced a very hard and durable coating with a solar absorptance of 0.91 at room temperature, and a solar absorptance of 0.87 with an emittance of 0.30 at 1000° F. Author

N65-26906* National Physical Lab. of Israel, Jerusalem.
SURFACES OF CONTROLLED SPECTRAL ABSORPTANCE
H. Tabor, H. Weinberger, and J. Harris *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 525–530 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

Given the optical constants (n–ik) of absorbing materials to be applied as interference films on metal surfaces, it is possible to calculate the film thicknesses in two- and three-layer systems required to achieve high absorptance for solar radiation but low thermal emittance. The methods of making such calculations are reviewed and results for nickel–nickel black systems are presented and discussed. Author

N65-26907* Lockheed Missiles and Space Co., Palo Alto, Calif.
AN EXPERIMENTAL DETERMINATION OF THE ABSORPTANCES OF CRYODEPOSITED FILMS USING CALORIMETRIC TECHNIQUES
R. P. Caren, A. S. Gilcrest, and C. A. Zierman *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 531–534 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75
(Contract AF 40(600)-992) CSCL 20M
CSCL 20M

This paper describes an experimental technique for measuring the absorptance of materials for radiation from a low temperature black body radiator. In particular, in the present experiments the absorptances of cryodeposited films of carbon dioxide, nitrogen, and air were measured for 77° K blackbody radiation. The apparatus and instrumentation are described and the experimentally measured absorptances are reported. Author

N65-26908* Philco Corp., Palo Alto, Calif.
THE STUDY OF LOW SOLAR ABSORPTANCE COATINGS FOR A SOLAR PROBE MISSION
E. R. Streed and C. M. Beveridge *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 535–547 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

A summary of available information is presented pertinent to the selection, application, and performance of thermal control coatings for use on a flight to 0.3 AU perihelion. Coatings with a solar absorptance of 0.30 or less and a total hemispherical emittance of 0.85 or greater at temperatures up to 500° F are desired. The results of an experimental program to measure the optical properties and to perform simultaneous exposure to simulated solar radiation, temperature, and high vacuum are described. Author

N65-26909* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTIVENESS OF SOLAR RADIATION SHIELDS FOR THERMAL CONTROL OF SPACE VEHICLES SUBJECTED TO LARGE CHANGES IN SOLAR ENERGYa TO LARGE CHANGES IN SOLAR ENERGY
John C. Arvesen *In* NASA, Washington Symp. on Thermal Radiation of Solids 1965 p 549–557 refs (See N65-26855 16-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

The effectiveness of a solar shield in providing thermal control of a Sun-oriented space vehicle traveling from the Earth to within 9 million miles (≈ 0.1 AU) from the Sun is studied. The capsule tested was conical in shape and the shield was a flat disk. The shield was placed at a given distance from the capsule and completely shaded the capsule from an infrared radiation source. The shield was heated by the source to a predetermined temperature representative of a certain distance from the Sun. The tests were conducted in a 4- by 5-foot vacuum chamber at a pressure level of less than 5×10^{-6} torr. The walls of the chamber were blackened and cooled with liquid nitrogen to simulate the thermal environment of space. The temperature rise on the capsule resulting from an increase in shield temperature is shown to be a function of the radiation configuration factors between the shield and the capsule, the total hemispherical emittances of the shields and capsules, and the internally generated heat. The necessity of considering the angular absorptance characteristics of the capsule is also discussed. Experimental results indicate that with shields and with constant internal power, the change in capsule temperature can be held to about 10° F for a shield temperature increase of 1000° F. Author

N65-26910* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EFFECT OF ABSORPTANCE–EMITTANCE RATIO IN THE STORAGE OF CRYOGENIC PROPELLANTS IN SPACE
C. H. Liebert and R. R. Hibbard *In* NASA, Washington, Symp. on Thermal Radiation of Solids 1965 p 559–566 refs. (See N65-26855-33) GPO: HC $3.75; CFSTI: MF $2.75 CSCL 20M

An analysis was performed to determine the effectiveness of spectrally selective surfaces with $\alpha/\epsilon < 1.0$ in reducing the heat transfer through the insulation of cryogenic-propellant tanks located in deep space. The analysis considered the effects of surface coatings with α/ϵ ratios varying from 0.1 to 1.0 applied to the external surfaces of either bulk insulation or multifoil insulation. Results were obtained in terms of the heat-transfer rate to two cryogenic propellants, liquid hydrogen and liquid oxygen, when stored at the Mercury, Earth, and Mars orbital distances from the Sun, with good insulation and correspondingly low heat-transfer rate to the propellant, the α/ϵ ratio is a reasonable criterion of merit for these coatings, but at larger heat-transfer rates consideration of ϵ (or α) is necessary. Selective coatings with $\alpha/\epsilon = 0.1$ on a given amount of bulk insulation material can reduce the heat-transfer rate to 40 to 55 percent of the rate with gray coatings. Or, for equivalent rates, a reduction in bulk-insulation-material thickness of about one-half is possible with high-quality selective coatings ($\alpha/\epsilon = 0.1$) as compared with the insulation needed for gray coatings. The heat-transfer rate for surfaces having an α/ϵ ratio of 0.1 may be only about 10 percent of that for gray surfaces; or, for a given heat-transfer rate, the use of approximately 10 times fewer foils of emittance 0.05 is possible when spectrally selective surfaces are employed. Author

N65-26961# Joint Publications Research Service, Washington, D. C.
ON THE PROBLEM OF THE RELATIONSHIP BETWEEN ENTROPY OF INFORMATION PROCESSES AND PHYSICAL ENTROPY
Ye. A. Sedov 30 Jun. 1965 18 p refs Transl. into ENGLISH from Vopr. Filosofii (Moscow), no. 1, 1965 p 135–145
(JPRS-30890; TT-65-31389) CFSTI: $1.00

The functional and logical relationships between thermodynamic entropy and information entropy are analyzed. The function $\sum p_i \log_e p_i$ which is used in measuring message entropy, has its maximum value when a body in thermodynamic equilibrium is characterized by a Gaussian probability distribution of velocities among its constituent parts. In a number of examples it is shown that this function can, quite generally, be used to characterize the objective properties of the statistical forms of motion, and to evaluate the degree of ordering of motion in the components of particular material systems.
J.M.D.

N65-26965# Michigan Univ., Ann Arbor. Infrared Physics Lab.
A HIGH-TEMPERATURE BLACKBODY RADIATION SOURCE
H. Y. Yamada Jun. 1965 20 p refs
(Contract ARPA SD-91; ARPA Order 236; Proj. Defender)
(Rept.-4613-86-T; AD-616758)

A high-temperature blackbody radiation source, consisting of an electrically heated graphite tube with a small centrally located hole through one wall, was developed for use as a secondary standard in the calibration of radiometric and spectrometric instruments. The spectral emissivity of this source, at 0.65μ, was calculated by the DeVos method, for which graphite emissivities and temperature gradients were measured in situ with an optical pyrometer. The values of source emissivity ranged from 0.9981 ±0.0004 at 1000° C to 0.9997 ±0.0002 at 2000° C. Author

N65-27054*# United Technology Center, Sunnyvale, Calif. Engineering Dept.
HEAT TRANSFER STUDIES OF SOLID ROCKET IGNITERS Quarterly Progress Report No. 3
B. G. Mullis 15 Apr. 1965 10 p ref Prepared for JPL
(Contract NAS7-302)
(NASA-CR-63540; UTC-2096-QPR-3) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Studies were continued on the development of techniques for predicting the flow phenomena and heat transfer of solid rocket igniters. The flow visualization tests and the setup and preliminary firing of the copper tube apparatus were completed. An analysis of wall heat transfer due to a cloud of radiating particles contained in a finite cylindrical duct was initiated.
R.N.A.

N65-27169# Naval Ordnance Lab., White Oak, Md.
CALCULATION OF DETONATION PARAMETERS WITH THE RUBY CODE
Harold Hurwitz Jun. 1965 27 p refs
(NOLTR-63-205; AD-615722)

The RUBY high-speed computer code, obtained by NOL from the Lawrence Radiation Laboratory, computes the detonation parameters of a given explosive from its chemical composition and known thermodynamic data. Preliminary computations have been carried out for TNT, PETN, and RDX, to examine the applicability of RUBY to problems of interest to NOL. In these computations the loading density, heat of formation of graphite, and the number of permitted gaseous products were varied. It was found that agreement with experimental values was good enough to warrant proceeding to further computations for explosives containing carbon, hydrogen, nitrogen, and oxygen, using the conventional zero value for the heat of formation of graphite. It was also noted that within the range of loading densities studied the detonation parameters vary approximately linearly with loading density. Author

N65-27211# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
THEORETICAL PERFORMANCES OF HYPERGOLIC PROPELLANT DIMAZINE–CHLORIDE TRIFLUORIDE SYSTEMS

Akira Iwama, Kiroku Yamazaki, and Ken Kikuchi Feb. 1965 15 p refs
(ISAS-395, Vol. 30, No. 4)

The results of calculation for the theoretical performance and various thermodynamic data of Dimazine~chlorine trifluoride propellant system and Dimazine: hydrazine (1:1)~chlorine trifluoride propellant system have been presented. The calculation was performed with the OKITAC 5090A at Computation Center, University of Tokyo. The maximum theoretical specific impulse of Dimazine≈chlorine trifluoride propellant system is 199.73 sec. at mixture ratio of 5.75 (P_c = 20 atm.), and that of Dimazine: hydrazine (1:1)~chlorine trifluoride propellant system is 216.33 sec. at mixture ratio of 3.575 (P_c = 20 atm.). Author

N65-27273*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DIRECTIONAL THERMAL-RADIATIVE PROPERTIES OF CONICAL CAVITIES
Leslie G. Polgar and John R. Howell Washington, NASA, Jun. 1965 30 p refs
(NASA-TN-D-2904) CFSTI: HC $2.00/MF $0.50 CSCL 20M

A Monte Carlo technique is applied to the problem of finding the apparent directional thermal-radiative reflectance, and emittance of a right circular conical cavity with a diffusely reflecting internal surface. Parameters examined are the cone angle, the cone surface absorptivity, and the angle of incident radiation. Small cone angles are found to produce a strong reflection back to the direction of incident radiation, while the results for large cone angles approach those for a flat plate. The Monte Carlo method is found to give a useful tool for solving problems of this type. The directional emittance results may be useful in the field of optical pyrometry, where the effect of viewing angle on the apparent temperature of a cavity is of interest. Some correlation to the reflection properties of the Moon are noted. Author

N65-27290# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EFFECT OF VIBRATION ON HEAT TRANSFER FROM CYLINDERS IN FREE CONVECTION
David F. Neely (M.S. Thesis) Aug. 1964 77 p refs
(GA/ME/64-2; AD-610173)

The purpose of this investigation was to determine the effect of diameter, temperature difference, and vibration intensity on the free convective heat transfer rate from horizontal cylinders subjected to transverse vibrations in air. The diameters of the cylinders used in this investigation were 0.085 and 0.25 inches. The cylinders were vibrated over a frequency range of 0 to 88 cycles per second and an amplitude range of 0 to 0.35 inches. The surface temperature of the cylinders ranged from 138 to 201 degrees Fahrenheit, and the maximum vibration intensity was 29 inches per second. Above vibration intensities of 12 inches per second, the variation of the heat transfer rate for both cylinders followed the forced convection curve recommended by McAdams, and the value of the heat transfer rate was independent of the temperature difference. For a given temperature difference and vibration intensity, the value of the heat transfer rate increased as the cylinder diameter decreased. An interferometer study showed that the boundary layer was turbulent above vibration intensities of 12 inches per second. Author

N65-27325# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
AN ANALYTIC STUDY OF VISCOUS EFFECTS IN A SLOWLY EXPANDING HYPERSONIC NOZZLE
Maurice L. Rasmussen and Krishnamurty Karamcheti Apr. 1964 166 p refs
(SUDAER-186)

The displacement and heat-transfer effects of laminar and turbulent boundary layers in slowly expanding hypersonic nozzles was investigated. Approximate solutions for the regions near the throat and far downstream are given. The role of the pressure gradient was brought out by the results of the analysis. It was found that heat transfer in the presence of a highly favorable gradient may be greatly reduced from that predicted by the usual flat-plate forms of Reynolds analogy. It was noted that the boundary-layer behavior may change from turbulent to laminar-like characteristics in the presence of cold walls and a highly favorable pressure gradient. E.E.B.

N65-27345*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CONVECTIVE AND EQUILIBRIUM RADIATION HEAT-TRANSFER PREDICTIONS FOR PROJECT FIRE REENTRY VEHICLE
P. Calvin Stainback Washington, NASA, Jul. 1965 76 p refs
(NASA-TN-D-2867) CFSTI: HC $3.00/MF $0.75

Approximate equilibrium flow fields were calculated for the forebody of the Project Fire reentry vehicle at zero angle of attack for five points along the trajectory. These flow-field calculations were based on wind-tunnel pressure and shock-shape data and the assumption of a quadratic variation of pressure and velocity across the shock layer. The results of these calculations were ultimately used to calculate the equilibrium radiation heat-transfer rate to the forebody of the vehicle. Convective heating rates were also calculated by using the wind-tunnel pressure data. Author

N65-27349*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EQUILIBRIUM HYDRODYNAMIC VARIABLES BEHIND THE PRIMARY AND REFLECTED SHOCK WAVES IN ARGON AND NITROGEN
Norman T. Grier Washington, NASA, Jul. 1965 50 p refs
(NASA-TN-D-2905) CFSTI: HC $3.00/MF $0.50 CSCL 20D

The hydrodynamic variables behind the primary and reflected shock waves have been calculated for shocked gas temperatures up to 100 000° K in argon and 40 000° K in nitrogen. The initial pressure ranged from 10^{-8} to 1 atmosphere. Single ionization of atomic nitrogen was assumed in the calculations of the thermodynamic properties of nitrogen. Author

N65-27370*# Battelle Memorial Inst., Columbus, Ohio.
ENGINEERING PROPERTIES OF POTASSIUM Eleventh Quarterly Report, 1 Apr.–30 Jun. 1963
Alexis W. Lemmon, Jr. 30 Jul. 1963 16 p refs
(Contract NAS5-584)
(NASA-CR-63583) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The viscosity, vapor pressure, thermal conductivity, and heat content of liquid potassium were measured. Vapor compressibility was measured on the pressure-volume-temperature apparatus. The design study of equipment to determine the specific heat of potassium vapor was completed. The vapor pressure and compressibility data were used to derive a virial equation of state which was used to compute the enthalpy, entropy, and specific heat of the vapor. The thermal conductivity and electrical resistivity of liquid potassium were measured to about 1150° C. The data are reliable to about 800° C. The anomalous behavior of the thermal conductivity data between 800° and 1150° C can be explained by potassium leakage within the

apparatus. Viscosity measurements of potassium vapor were indefinitely suspended. Values for the specific heat of potassium were computed from known thermodynamic relations and a previously derived virial equation of state. Design and construction continued on the dynamic, bare-wire probe apparatus for the thermal conductivity measurements of potassium vapor. R.N.A.

N65-27371*# Battelle Memorial Inst., Columbus, Ohio.
ENGINEERING PROPERTIES OF POTASSIUM AND CESIUM Twelfth Quarterly Report, 1 Jul.–30 Sep. 1963
Alexis W. Lemmon, Jr. 30 Oct. 1963 12 p refs
(Contract NAS5-584)
(NASA-CR-63582; BATT-4673-Q12) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The viscosity, vapor pressure, thermal conductivity, and heat content of liquid potassium, and the compressibility of potassium vapor were measured. The vapor pressure and compressibility data were used to derive a virial equation of state for the computation of enthalpy, entropy, and the specific heat of the vapor. E.E.B.

N65-27372*# Battelle Memorial Inst., Columbus, Ohio.
ENGINEERING PROPERTIES OF POTASSIUM AND CESIUM Thirteenth Quarterly Report, 1 Oct.–31 Dec. 1963
Alexis W. Lemmon, Jr. 30 Jan. 1964 16 p refs
(Contract NAS5-584)
(NASA-CR-63589; BATT-4673-Q13) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The effort on potassium is currently limited to the operation and evaluation of the bare-wire-probe apparatus to obtain values for the thermal conductivity of the vapor. Measurements of the thermal conductivity of nitrogen gas at room temperature was found to be 2.6 ±0.5 W/sq cm per deg C, as compared with a literature value of 2.7 W/sq cm per degree C. Measurements on potassium vapor between 400° and 800° C revealed that potassium does not respond as nitrogen. Preparations for the viscosity measurements on liquid cesium are nearing completion. E.E.B.

N65-27395*# Rocketdyne, Canoga Park, Calif.
BOILING HEAT TRANSFER FOR CRYOGENICS
J. D. Seader, W. S. Miller, and L. A. Kalvinskas Washington, NASA, Jun. 1965 171 p refs
(Contract NAS8-5337)
(NASA-CR-243) CFSTI: HC $5.00/MF $1.00 CSCL 20M

An extensive survey of available information from the literature on heat transfer to boiling hydrogen, nitrogen, and oxygen is presented. Included are a bibliography of available experimental data, a summary of boiling theory, graphical comparisons of the experimental data, and compilations of pertinent physical properties for each of the three cryogenic fluids. Author

N65-27404# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Freiburg (West Germany). Institut für Angewandte Mathematik und Mechanik.
ON AN IMPROVED THEORY OF HEAT TRANSFER IN THE PRESENCE OF LARGE TEMPERATURE AND PRESSURE GRADIENTS IN MAIN FLOW DIRECTION [BEITRAG ZUR THEORIE DES WARMEUBERGANGS BEI STARKEN TEMPERATUR- UND DRUCKGRADIENTEN IN STROMUNGSRICHTUNG FUR EBENE UND ROTATIONSSYMMETRISCHE GRENZSCHICHTEN]
Alfred Walz May 1965 57 p refs In GERMAN; ENGLISH and FRENCH summaries
(DVL-419; DLR-FB-65-21) Available from Zentralstelle fuer Luftfahrtdokumentation und Inform. (ZLDI) Munich: 15.20 DM

An approximation theory valid for compressible laminar and turbulent boundary layers is developed to account for temperature and pressure gradients which may vary arbitrarily along the wall. This theory is characterized by the introduction of a "modifying parameter" within the solution statement for the temperature profile. Thus, together with the momentum-loss thickness and the shape parameter of the velocity profile the theory contains three unknowns. These unknowns may be determined by solving the simultaneous system of three ordinary differential equations of first order (integral conditions of momentum and energy). Practicability and accuracy of this theory are checked by a number of sample calculations. Author

N65-27414# Aeronautical Research Council (Gt. Brit.).
FREE-FLIGHT MEASUREMENTS OF PRESSURE AND HEAT TRANSFER IN REGIONS OF SEPARATED AND REATTACHED FLOW AT MACH NUMBERS UP TO 4
J. Picken 1965 72 p refs Supersedes RAE-AERO-2643, ARC-22618
(ARC-CP-706; RAE-AERO-2643, ARC-22618)

Local heat transfer and surface pressure have been measured over regions of separated flow associated with a turbulent boundary layer. The separated flow was appropriate to aft facing steps of various heights behind a sting mounted cone of 15° semi-angle. The maximum Mach number achieved was about 4 and the maximum Reynolds number about 50×10^6 based on cone length. Two different forms of wake were detected: one associated with reattachment on the sting, i.e. a relatively great convergence of the wake boundary, and one associated with reattachment on a conical surface aft of the sting, i.e. a small wake convergence. Differing patterns of heat transfer and pressure distributions were obtained depending on which type of flow occurred. Some collapse of the separated flow heat transfer data with respect to Mach number was obtained by comparing them with estimated values appropriate to local conditions outside the wake. Close to the step the heat flow in the separated region was about 25% of the estimated value for attached flow to a solid surface replacing the wake boundary. Towards and beyond reattachment the ratio of the two values rose to near unity. The reattachment is ratio of the two values rose to near unity. The measurements suggest that the amount of heat transder rise at and beyond reattachment is dependent upon the wake convergence, becoming smaller as the convergence increases. This is qualitatively consistent with the known effect that increasing convergence implies increasing boundary layer thickness at reattachment. There was no evidence of a marked maximum in the heat flux in the reattachment region. Author

N65-27512*# National Beryllia Corp., Haskell, N. J.
RESEARCH ON THERMAL TRANSFER PHENOMENA First Quarterly Status Report, Jan. 1–Mar. 31, 1965
Karsten H. Styhr [1965] 11 p
(Contract NASw-1197)
(NASA-CR-63650) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Mechanisms such as absorption and reradiation by embedded particles, scattering by incorporated phases, and reflection by metallic foil radiation barriers are investigated. A high-temperature thermal conductivity test cell capable of maintaining, under steady state conditions, specimen hot face temperatures of 4500° F and above was fabricated and calibrated. Composites of zirconium dioxide foamed ceramic with ten weight percent zirconium metal additions were prepared. Foamed refractory shapes were prepared of zirconium dioxide containing 10 wt.% zirconium diboride as a potential thermal radiation barrier phase. X-ray data on specimens fired in air up to 1100° and 1700° C indicate that the diboride

oxidizes under firing conditions. Conductivity measurement runs on three zirconium dioxide matrix foams of high purity raw material, but with slight variations in density and strength, confirmed that mechanical failure grossly affects the thermal conductivity versus temperature curve. R.W.H.

N65-27549# Princeton Univ., N. J.
LAMINAR MIXING AND HEAT TRANSFER PHENOMENA BETWEEN A PARTIALLY IONIZED GAS AND A GASEOUS COOLANT
Jerry Grey, Peter M. Williams, David B. Fradkin, Paul F. Jacobs, and Martin P. Sherman Wright-Patterson AFB, Ohio, ARL, Apr. 1965 111 p refs
(Contract AF 33(657)-9962)
(ARL-65-73; AD-615560)

Mixing and heat transfer characteristics of a laminar subsonic argon arcjet issuing into a stagnant atmosphere of room-temperature helium were investigated: The analysis was based on classical continuum theory using the boundary layer approximation. Detailed local measurements of the mixing field were made up to five inches downstream of the arcjet nozzle exit using a calorimetric sampling capsule capable of measuring local values of enthalpy, stagnation pressure, and gas composition. Good correlation between theory and experiment were observed. Decay of the hot laminar jet was dominated by the inflow of helium. The observed effects of ion recombination, radiation, and jet dispersion were minor or negligible. The behavior resulted from the high specific heat and high diffusion coefficients at arcjet temperatures. The departure from equilibrium between the electrons and the heavy particles was small when considering the overall mixing process but this equilibrium probably did not exist in the regions of highest temperature gradient. R.N.A.

N65-27550*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FORMULAS FOR RADIANT HEAT TRANSFER BETWEEN NONGRAY PARALLEL PLATES OF POLISHED REFRACTORY METALS
J. Robert Branstetter Washington, NASA, Jun. 1965 19 p refs
(NASA-TN-D-2902) CFSTI: HC $1.00/MF $0.50 CSCL 22M

Hemispherical emittance, both total and normal, were calculated from normal spectral-emittance data obtained from other sources. The metals evaluated were clean, polished tungsten, molybdenum, and tantalum, each of which exhibits spectral emittances that vary considerably with temperature and wavelength. Net radiant heat flow between two parallel, infinite plates was computed by summing the monochromatic energy exchange. The evaluation was made for all nine possible combinations obtained by interchanging metals on the two surfaces. The results are graphically presented as a function of the temperatures of the two surfaces. Equations were fitted to each of the nine sets of heat-flux calculations. Values of the constants are presented along with contour plots showing the temperature regions in which the equations are accurate to 7 and 11 percent, respectively. The computational procedures for obtaining the heat flux and the constants in the arbitrary equations are described. Author

N65-27569# India. Dept. of Atomic Energy, Bombay. Health Physics Div.
TEMPERATURE DISTRIBUTION IN RADIOACTIVE SOLIDS. PART II: GAMMA-ACTIVE SPHERES
V. K. Sundaram, D. V. Gopinath, and A. K. Ganguly 1964 31 p refs
(AEET/HP/TH-20)

Analytical expressions are given for heat source distribution and for calculation of temperature distribution in and out of a solid sphere containing gamma activity and buried in a medium having the same thermal properties as the source body. Numerical values obtained with energies in the range of 0.5 to 3 Mev and in spheres of radii 10, 20 and 30 cms. are presented. Under steady state conditions, with increasing radius of the sphere, the ratio of the temperature obtained at the centre and at the surface is found to approach the value of 1.5. The same ratio has been reported by Kotewale and Ganguly in the case of beta active sphere. It is also observed that the temperature rise due to low energy (0.5Mev) gammas contained in large spheres (30 cms) approaches three times that obtained in similar beta active sphere of same maximum beta energy. Author

N65-27788*# Case Inst. of Tech., Cleveland, Ohio.
EXPANSION THEOREMS FOR SOLUTIONS OF TWO GENERALIZATIONS OF THE HEAT EQUATION Report No. 209
Allen T. Hopper May 1965 88 p refs
(Grant NsG-544)
(NASA-CR-63700) CFSTI: HC $3.00/MF $0.75 CSCL 20M

Expansion theorems for classical solutions of the equations

$$\text{(I)}\ \frac{\partial u(x,t)}{\partial t} = (-1)^{j+1}\,\frac{\partial^{2j} u(x,t)}{\partial x^{2j}},\ q = 2j,\ j = 1,2,\ldots,$$

and

$$\text{(II)}\ \frac{\partial u(r,t)}{\partial t} = (-1)^{j+1}\Delta_n^j \cdot u(r,t),\ j = 1,2,\ldots,\ n = 2,3,\ldots,$$

are developed which relate expansions of classical solutions in terms of Huygens' principles and the entireness properties of initial data and solution functions. Expansion theorems for solutions of equation I are obtained in terms of the two basic sets:

(1) the set $\{v_q^k(x,t)\}_{k=0}^{\infty}$

of generalized heat polynomials, and

(2) the set $\{w_q^k(x,t)\}_{k=0}^{\infty}$

of associated functions. Solutions of equation II are examined in terms of either the set

$$\{R_{j,n}^k(r,t)\}_{k=0}^{\infty}$$

of generalized radial heat polynomials or the set

$$\{S_{j,n}^k(r,t)\}_{k=0}$$

of associated radial functions. Results are extended in a number of ways to include a larger class of related functions. Extensions to Euclidean n-space are also considered. E.E.B.

N65-27819*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN AUTOMATIC SYSTEM FOR DETERMINING SOLAR ABSORPTANCE AND THERMAL EMITTANCE OF SURFACES FROM SPECTRAL NORMAL REFLECTANCE MEASUREMENTS
Louis A. Teichman and Harold D. Burk Washington, NASA, Jul. 1965 13 p refs
(NASA-TM-X-1113) CFSTI: HC $1.00/MF $0.50 CSCL 20M

An automatic system is described for use in determining the solar absorptance and thermal emittance of surfaces from spectral reflectance measurements. The system consists of two spectrophotometers used to make optical reflectance measurements, electronic digitizing equipment to record the data, and a high-speed electronic computer to calculate the desired results. Manual and automatic means of data reduction are compared to determine the reliability and reproducibility of the system. A significant decrease in data reduction time is realized with use of the automatic system. Author

N65-27822*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HEAT TRANSFER IN THE VICINITY OF A TWO-DIMENSIONAL PROTUBERANCE
Ed Murphy 11 May 1965 32 p refs
(NASA-TM-X-53257) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Empirical equations are presented which will estimate the ratio of protuberance-to-flat plate heat transfer coefficients for supersonic flow in the vicinity of two-dimensional protuberances in a turbulent, supersonic boundary layer. The equations were derived from experimental heat transfer data taken around several two-dimensional protuberances, i.e., a 1 × 2-inch stringer, a 2 × 4-inch stringer with and without a 30-degree wedge, and a one-quarter cylinder forebody. Important parameters in the equations are boundary layer thickness, protuberance geometry, Reynolds number, and Mach number. Using the equations, the average deviation between estimated and experimental ratios is from −9 to +15 percent. Author

N65-27848# National Engineering Science Co., Pasadena, Calif.
INVESTIGATION OF THE FEASIBILITY OF SYNERGISTIC ENHANCEMENT OF HALOGENATED FIRE EXTINGUISHANTS Technical Report, Nov. 1963–Jan. 1965
Herbert Landesman, John E. Basinski, and Eugene B. Klusmann Wright-Patterson AFB, Ohio, Aero Propulsion Lab., Mar. 1965 68 p refs
(Contract AF 33(615)-1161)
(SN-170; AFAPL-TR-65-10; AD-616101)

This report presents results of a program to test the feasibility of synergistically enhancing the effect of halogenated fire extinguishants with addition of free radical initiators. The effect has been found to be only marginal or non-existent over the concentration range of initiator-chlorobromo-methane mixtures used in this work. Data are presented from screening for the synergistic enhancement effect by means of 1) flame speed measurements of hydrogen-air flames to which initiator-inhibitor mixtures are added, 2) flammability limits of heptane-air flames to which initiator-inhibitor mixtures are added, and 3) small scale pan fire tests using initiator-extinguishant mixtures. Author

N65-27893# RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND THE COMPUTATION OF INTERNAL FIELDS FOR TRANSPORT PROCESSES
R. E. Bellman, H. H. Kagiwada, R. E. Kalaba, and Sueo Ueno Feb. 1965 17 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4472-PR; AD-610752)

A classical problem of long standing in the theory of transport processes is the determination of the internal intensity function in a finite, homogeneous, isotropically scattering slab which is illuminated by uniform parallel rays of radiation. The authors provide an effective computational solution for this problem using an imbedding technique. They show how to compute the source function, characterized as the solution of a system of ordinary differential equations with a complete set of initial conditions. The X and Y functions of Chandrasekhar play a key role. Author

N65-27927# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATING THE CHARACTERISTICS OF IGNITING A STREAM OF HOT GASES BY COUNTER STREAMS
S. A. Gol'denberg and L. S. Solovyeva 16 Dec. 1964 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Energ. i Transp. (USSR). no. 1, 1964 p 116–122 (FTD-TT-64-590/1+2; AD-610410)

Flame stabilization was investigated by experimentally determining the effect of counter air and methane–air streams on the flame of a homogeneous gasoline–air mixture. It is shown that theoretical calculation of flame stabilization curves coincide sufficiently well with experimental data. It was observed that flame stabilization with a counter air stream is highly effective even at nozzle dimensions of less than 1 mm in diameter and at pressures of 1.5 gage atmospheres or higher. The characteristics of a stabilizing stream theoretical analysis showed that the process of flame stabilization with counter and plain lateral streams is determined by the structure of various zones formed by the stream and flow reaction and by the characteristic dimensions of the flow. E.E.B.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-26794# Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS
Apr. 1965 56 p refs

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N65-26914# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 190
23 Jun. 1965 16 p Transl. into ENGLISH of Chinese articles (JPRS-30758; TT-65-31319) CFSTI: $1.00

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N65-27000# American Ordnance Association, Washington, D. C. Materials Div.
MATERIALS PERFORMANCE FOR DEFENSE AND SPACE PROGRAMS
19 Nov. 1964 250 p Rept. of tech. meeting held at Wright-Patterson AFB, Ohio, 23–24 Sep. 1964
(AD-461995)

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2. INTRODUCTORY REMARKS FOR THE NAVY PRESENTATION N. E. Promisel (Bur. of Naval Weapons) 2 p

3. DEEP SUBMERGENCE MATERIALS FOR THE NAVY P. A. Gisvold (Bur. of Ships) 16 p (See N65-27002 16-34)

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5. CURRENT PROBLEMS IN FERROUS METALLURGY G. W. Roust and H. W. Zoeller (AFSC) 23 p (See N65-27003 16-17)

6. LIGHT METALS C. B. Ward (AFSC) 6 p (See N65-27004 16-17)

7. A REVIEW OF HIGH TEMPERATURE NONFERROUS METALS TECHNOLOGY D. R. James (AFSC) 15 p (See N65-27005 16-17)

8. AIR FORCE INTERESTS IN CERAMICS J. D. Latva (AFSC) 20 p refs (See N65-27006 16-17)

9. AIR FORCE REQUIREMENTS AND PROGRAMS PLASTICS R. C. Tomashot (AFSC) 8 p (See N65-27007 16-18)

10. POWDER METALLURGY G. W. Trickett (AFSC) 6 p (See N65-27008 16-17)

11. AIR FORCE REQUIREMENTS FOR PROPELLANTS D. A. Hart (AFSC) 4 p (See N65-27009 16-27)

12. MATERIALS FOR THE MACH 3 SUPERSONIC TRANSPORT G. C. Deutsch (NASA, Washington) 9 p (See N65-27010 16-02)

13. MATERIALS—MEN, MONEY, AND MISSIONS Earl T. Hayes (Defense Dept.) 4 p

14. STATE OF THE ART ON NONFERROUS METALS W. A. Dean (Aluminum Co. of Am.) 32 p (See N65-27011 16-17)

15. STATE OF THE ART IN PLASTICS E. O. Hausmann (Budd Co.) 6 p (See N65-27012 16-18)

16. POWDER METALLURGY. A REVIEW A. D. Schwope (Clevite Corp.) 5 p (See N65-27013 16-17)

17. REPORT OF THE PROPELLANTS AND EXPLOSIVES SECTION TO THE MATERIALS DIVISION, AMERICAN ORDNANCE ASSOCIATION A. M. Ball 1 p

18. COMBUSTIBLE CARTRIDGE CASES K. H. Russell (Picatinny Arsenal) 20 p

19. CASELESS AMMUNITION FOR SMALL ARMS Milo A. Fry (Frankford Arsenal) 4 p

20. A STATUS REPORT ON CERAMIC TECHNOLOGY M. G. Britton (Corning Glass Works) 18 p (See N65-27014 16-17)

21. AMERICAN ORDNANCE ASSOCIATION H. L. Allen (Republic Steel Corp.) 7 p

22. SUMMARIES OF PROCEEDINGS, TECHNICAL SECTION MEETINGS 29 p

N65-27002 Bureau of Ships, Washington, D. C. Materials and Chemistry Branch.

DEEP SUBMERGENCE MATERIALS FOR THE NAVY

P. A. Gisvold *In* Am. Ordnance Assoc. Mater. Performance for Defense and Space Programs 19 Nov. 1964 16 p (See N65-27000 16-34)

Deep submergence has received increased emphasis for many reasons, a few of which are: (1) real estate; (2) wealth in the form of food, minerals, and oil; (3) communications; (4) rescue and salvage; and (5) general search for knowledge of the unknown. A brief discussion is given one each of the listed reasons. The material problem in deep submergence is discussed with emphasis on hull or shell materials and structures. Materials discussed were titanium, steels, and fiber reinforced structural material. The organizational pattern that is involving or exist for implementing the deep-submergence program in the Navy is discussed. N.E.A.

N65-27051*# Washington Univ., St. Louis, Mo. Dept. of Economics.

FEDERAL RESOURCES AND URBAN NEEDS

Murray L. Weidenbaum [1965] 41 p refs Presented at Washington Univ. Conf. on Planning for the Quality of Urban Life *Its* Working Paper 6507

(Grant NsG-342)

(NASA-CR-63517) CFSTI: HC $2.00/MF $0.50 CSCL 05C

Future implications of the changing patterns of defense and space expenditures are analyzed. Possibilities for transferring potentially available financial and physical resources from Federal programs to state and local governments are explored. Extrapolations are made for estimating future revenues and expenditures, and gross national product. L.S.

N65-27160# RAND Corp., Santa Monica, Calif.

PUBLIC POLICY TOWARD SUBCONTRACTING

Robert E. Johnson and George R. Hall May 1965 59 p refs (Contract AF 49(638)-700; Proj. RAND)

(RM-4570-PR; AD-615656)

The need for subcontracting regulations in the aquisition of weapon systems is examined, current subcontracting policies are analyzed, and some changes in the current policies are suggested. The government should be concerned with all contracts let without effective price competition because prime contractors lack the motivation to minimize target costs. Policy suggestions that deal with subcontract provisions focus on the follow-on procurement problem to obtain price protection and flexibility in the face of uncertain demands. The use of options permits it to base the initial selection of vendors on the total program costs. G.G.

N65-27225# Joint Publications Research Service, Washington, D. C.

IZVESTIYA VUZOV: RADIOPHYSICS, VOLUME VIII, NO. 1, 1965

24 Jun. 1965 289 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 8, no. 1, 1965 p 7-209

(JPRS-30776; TT-65-31330) CFSTI: $6.00

Radiophysics studies of plasmas, lasers, and properties and consequences of waves radiating over particular surfaces are presented. For individual titles see N65-27226-N65-27255.

N65-27389*# Washington Univ., St. Louis, Mo. Dept. of Economics.

EMPLOYMENT IMPACTS OF DEFENSE EXPENDITURES AND OBLIGATIONS

Edward Greenberg 29 Apr. 1965 28 p refs *Its* Working Paper No. 6505

(Grant NsG-342)

(NASA-CR-63613) CFSTI: HC $2.00/MF $0.50 CSCL 15C

The importance of accurately specifying the impacts of military procurement in models of the economy is discussed. One of the potentially most important applications of such models is to generate the responses of the economy to changes in procurement activity and to evaluate the effects of alternative courses of government action designed to reduce the economic hardships associated with large and rapid changes in military procurement. Based on the description of the government

spending process and the regressions for the aerospace industry, the important role played by the obligations variables is demonstrated. Evidence is presented to indicate that two proxies for announcement effects—budget and unobligated appropriations—have substantial impacts on employment. E.E.B.

N65-27436# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 189
22 Jun. 1965 38 p Transl. into ENGLISH of selected Chinese articles
(JPRS-30738; TT-65-31307) CFSTI: $2.00

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N65-27440# Joint Publications Research Service, Washington, D. C.
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(JPRS-30787; TT-65-31336) CFSTI: $1.00

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N65-27695# Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS, AUGUST 1964
S. Bowyer et al Aug. 1964 53 p refs CFSTI: $1.25

An Aerobee rocket was launched to observe the lunar occultation of X-ray emission from the Crab Nebula to prove or disprove the hypothesis that the X-ray source was the remnant of a supernova. If so the rocket-borne instruments would detect a point rather than a diffuse source. The source faded out gradually and it is now believed to be a cloud of very hot gas rather than a star. In another study, radar echoes reflected from the ionosphere and observed with a 150-foot antenna were observed more frequently when the radar beam was orientated in certain favored directions with respect to the earth's magnetic field. Studies showed that these echoes are associated with the visible aurora, solar flares, geomagnetic storms, and polar blackout of communications. Also included are summaries of progress on individual research projects in the fields of chemistry, electricity, mechanics, metallurgy and ceramics, nuclear and atomic physics, radio, solid state physics, and sound. R.N.A.

N65-27708*# National Aeronautics and Space Administration, Washington, D. C.
ESTABLISHMENT OF THE SWISS ASSOCIATION FOR SPACE RESEARCH [CREATION DE L'ASSOCIATION SUISSE POUR LES RECHERCHES SPATIALES]
Jun. 1965 2 p Transl. into ENGLISH from Rech. Spatiale, v. 4, no. 5, 1965 p 61
(NASA-TT-F-9422) CFSTI: HC $1.00/MF $0.50 CSCL 05A

This new organization includes about 50 representatives of scientific institutes and industrial enterprises as well as a hundred personalities from the university and business world. The Association will be concerned with the formation of groups of experts, the relationship of Switzerland with international space organizations, and the study of interesting projects of a number of Swiss enterprises. The study will deal in particular with the conditions which will enable Switzerland to construct a receiving station to receive satellite telecommunications. E.E.B.

N65-27744# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE SENSATION OF EARTH
V. S. Farfel' 2 Feb. 1965 10 p Transl. into ENGLISH from Zdor. (Moscow), no. 5, 1963 p 4–5
(FTD-TT-64-896/1; AD-611053)

Response to the force of gravity by the skin, the cochlea, visceral organs, and body fluids, and their functions in enabling humans to maintain vertical equilibrium, are discused in non-technical language. J.M.D.

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N65-27097 # 16-10 ..... RADC-TR-64-563, VOL. IV
N65-27098 # 16-25 ..... RADC-TR-64-563, VOL. V
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